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AUTHOR Calfee, Robert C.; And Others
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ABSTRACT

This paper presents an extensive, critical review of Eleanor Gibson and Harry Levin's "The Psychology of Reading." Treating the book as an attempt at comprehensive integration of the literature on the reading process, the reviewers look for a theoretical account that will bind findings together, for a critical examination of the research literature, and for an evaluation of practical consequences of the research efforts mounted over past years. After reviewing the scope of the Gibson and Levin book, the paper compares the work with its predecessors. Specific topics covered in the book are examined in detail, on an almost chapter-by-chapter basis. Concluding that other efforts to treat the psychology of reading have more nearly achieved their purposes than have Gibson and Levin, the reviewers go on to outline both what they feel we have learned about the topic and the fundamental questions remaining to be answered. (AA)

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A review by

Robert C. Calfee
Stanford University
Richard Arnold
Purdue University
Priscilla Drum
University of Colorado

of

The Psychology of Reading, by
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BOOK REVIEW*

Robert C. Calfee
Stanford University
Richard Arnold
Purdue University
Priscilla Drum
University of Colorado

The Psychology of Reading, by Eleanor J. Gibson and Harry Levin. Cambridge, Mass.: MIT Press, 1975. xii + 630 pp. $18.95.

Most people agree that both reading and learning to read are complex and variegated phenomena.[1] Each new volume on these topics is greeted with the hope that it will clarify our understanding, for hanging in the balance are decisions about how to teach this most vital of practical cognitive skills. The Psychology of Reading by Eleanor Gibson and Harry Levin aims at a comprehensive integration of the literature on the reading process. The task was last attempted almost a quarter century ago (Anderson & Dearborn, 1952), while Huey's (1908) landmark work was half a century earlier.[2]

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[1]For an exception see Furth (1970, p. 4).

[2]The books by Tinker (1965) and F. Smith (1971) do not exhibit the same degree of comprehensiveness; there are many specialized collections (e.g., Kavanaugh & Mattingly, 1972) and numerous works directed to training teachers (e.g., Durkin, 1970; Guszak, 1972). Chall's (1967) book is an effort to present a well-organized summary of research relevant to the teaching of reading.

What should we expect from Gibson and Levin's presentation? First, we hope for a theoretical account to bind together and make sensible what we already know and to direct what we need to find out. Second, we should like to find a comprehensive and critical examination of the research literature--a demanding task, given the enormous outpouring of investigations of uncertain quality. Third, for the audience of teachers, program developers, reading specialists, and others with instructional responsibility, we look for an evaluation of the practical consequences of the research activities mounted over past years.

In the preface and introduction Gibson and Levin promise us attention to these issues. Properly faulting earlier works for failing to provide a good theory of how a student learns to read, they propose to create "a theory of perceptual learning and a demonstration of its relevance for understanding the reading process" (p. 11). It appears, however, that an important distinction is glossed over in these early pages--the difference between a model for how a youngster learns to read and a model for the performance of a skilled reader.

Because most American citizens learn to read through classroom instruction, the critical elements in this process are the teacher and the instructional program.[3] But Gibson and Levin make their position clear at the beginning: There is, on the one hand, theory-based laboratory research on the reading process and, on the other, curriculum research on teaching methods. The latter has yielded no payoff; hope necessarily lies with the former (p. 4). One may properly fault the methodology in much curriculum research and bemoan the small yield from it (Cronbach, 1964); unfortunately, theory-based research is in little better position to trumpet its benefits.

We agree with Gibson and Levin about the proper role of the researcher vis-a-vis the practitioner:

> Advice about instruction or comparison of programs, or prescriptions about what to do with retarded readers, cannot take the place

[3] A few learn to read before they enter school or through informal instruction, and it doesn't seem to hurt them (Durkin, 1966, 1974).

> of giving the potential teacher the intellectual tools to think for himself when problems arise. There is no such thing as a pedagogical panacea. Problems will arise, new ones, because children are different and environments are different. The teacher must be able to accommodate to them independently by providing the environment and the materials that the child's particular needs demand. We believe that we can be most helpful to teachers and others concerned with the teaching of reading by giving them insights into the process of reading rather than dogma. The aim is to help them solve problems, not to provide a cookbook approach. (p. 10)

But we doubt that "intellectual tools" will spring naturally from theory-based research as carried on today by experimental and educational psychologists. Our quarrel is not with the concept of adequate control; this is fundamental. Nor is it with the activities of fellow psychologists; their renewed interest in practical problems is revitalizing the field. Rather, we question the idea that principles and procedures from the laboratory transfer directly to the multifaceted events of the classroom. Laboratory study of reading cannot long prosper in ignorance of variables central to curriculum research--the methods of instruction, the materials of instruction, and the context of instruction. Chall's (1975) counsel seems wise.

> University-based educational researchers tend generally to "work around" classroom teachers. Yet less than 50 years ago it was otherwise, with educational researchers and teachers collaborating at all levels of the research enterprise Indeed, many of the educational researchers during the 1920s and 1930s were themselves classroom teachers and/or school administrators. Carleton Washburne, for example, was superintendent of the Winnetka, Illinois schools when he conducted his pioneering and widely influential studies on readability and

> reading readiness. His subjects were children in the Winnetka schools and his research collaborators were the teachers and librarians. Of even greater significance is the fact that the studies were conducted on practical concerns of the teachers and schools. The collaboration between researchers and practitioners went even further, with joint authorship of journal articles, research monographs, and books. Further, they were meant to be, and were, read not by researchers alone but by practicing classroom teachers. . . .
>
> Generally, we need to recapture the spirit of collaboration between researchers and teachers characteristic of the 1920s and 1930s. I propose it not out of nostalgia, but as a way to restore the dignity and self-worth of teachers by involving them in the important educational experimentation of the day. I propose it also for the researcher and curriculum developer who are in danger of directing their work only to other researchers rather than to the ultimate users of the research. (Chall, 1975, pp. 173-174)

Gibson and Levin do not hesitate to make pronouncements about the curriculum and the teacher--they have much to say about both. They frequently drop the mantle of researcher and assume the guise of adviser and counselor. The reader of educational research should be wary. Is the statement a generalization supported by research? Is it a mandate for a course of action? If so, what evidence supports the action? Researchers may give advice, certainly, but they should make clear when they speak from research experience and when they offer opinion.

The Scope of the Book

Let us briefly survey the book's coverage. The first two chapters lay out a theory of perceptual learning and

cognitive development. The concepts of the theory are threaded through the remainder of the book. (To be sure, a somewhat different position is presented in the later chapter on theoretical models of skilled reading.) The next two chapters cover linguistic concepts and language development. An effort is made to render these compatible with the theory of perceptual learning and relevant to reading. Chapters on writing systems and on word perception finish the treatment of the basic concepts underlying reading.

Part II of The Psychology of Reading covers developmental reading. The authors tend to avoid the word teaching, but one finds synonyms such as training and developing skills. Over one hundred pages are devoted to early reading. The authors puzzle over the trouble some young children experience learning the written language in contrast to the ease with which they learn the spoken version. They discuss the elements that link the two systems in the skilled reader. While teaching methods are not discussed per se, different approaches are illustrated through exemplary reading programs.

The next two chapters, "Transition to Skilled Reading" and "Learning from Reading," contain topics relevant to older children and mature readers: reading and spelling, eye movements, comprehension, and making inferences. The need for an adequate theory of comprehension is discussed.

The final chapter in this section, "Models of the Reading Process," is a culmination, though Part III follows. From the first, the authors have stressed the importance of their theory of perceptual learning to reading. One therefore expects a model to further elaborate the theory. Instead, Gibson and Levin claim that since there is no single reading process, but many, neither can there be a single model for reading. Instead, they choose to elaborate general principles. First, several information-processing models are presented and dismissed. Then case studies of mature readers are presented to justify the contention that "there are as many reading processes as there are people who read." Finally, the authors list three major principles to sum up what has gone before. The chapter and section end: "Finally, we conclude that the reading process is rule governed and incapable of adequate description in simple terms" (p. 482).

Part III, "Questions People Ask About Reading," is a collection of topics that do not fit elsewhere. Included are discussions on dyslexia, dialect variations, cross-national comparisons, speed-reading, and how parents can facilitate progress in reading.

The Tradition

It is inevitable that Gibson and Levin be compared with their predecessors. What are the major trends in theory, research, and practice? Are we making progress? What are our needs and goals for the next decade or two?

Reading Huey (1908) gives one respect for the early impact of scientific investigations on our knowledge of the reading process, and for how much remained to be learned. Huey describes his work on visual components of skilled reading and links it to the classic studies of Cattell (1885), Javal (1879), and Erdmann and Dodge (1898), among others. This early work holds up well against today's computer-assisted research (e.g., Rayner, 1975). Research is covered in a readable narrative, and the attempt to integrate what is known comes off well. Where empirical evidence fails, reflection and introspection answer the issues of the day. Huey's sensitivity to the importance of the language base in reading is remarkably appropriate today.[4]

Huey's pedagogy reflects the art of teaching at the turn of the century and appears quaint by present standards; nonetheless, much that he says foreshadows Chall's (1967) "Great Debate." He reflects on issues that plague us even today. He bemoans the inanity of the content of primary readers: "It is a fat rat. Does the cat see the rat?" There is, unfortunately, a modern ring to his example.

All in all, Huey remains worthwhile reading after nearly three-quarters of a century, a book that serves both the researcher and the teacher as a source of information and a stimulus for thought.

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[4] In 1963 it was still possible for a review on teaching reading to begin, "This review contains only minor references to theories of language and such studies in linguistics which have possible implications--still largely unrealized--for the use of phonics and other approaches in reading instruction" (Russell & Fea, 1963).

Anderson and Dearborn (1952), writing at mid-century, were able to draw on a much larger data base than Huey. The new generation of researchers included Bloomfield, Bond, Davis, Durrell, Gates, Gray, Thorndike, Tucker, and Vernon, among others. Much research was applied--investigation of practical problems by people from a practical background. There were the extensive studies of typography by Tinker and his colleagues (Tinker, 1946; Tinker and Paterson, 1928). Anderson and Dearborn are comfortable with details: Uppercase print is read more slowly (10% to 15% slower) than regular uplow case. The reader is remarkably adaptive to variation in type font, type size, and line width, though exceptions to this generalization exist. Old English and Gothic type fonts are harder to scan; eight-point and smaller type slow the reader, as do line widths shorter than two inches or longer than six inches. The loss in speed is 5% or more beyond these size and width limits. The recommendations are accurate and empirical: "The printer may employ 9, 10, 11 or 12 point type, provided he employs an optimal line width and leading" (Tinker, 1965, p. 141). Line width for these type sizes can range from 2-1/2 to 5 inches, and the leading (interline spacing) should range from 1/72 to 4/72 of an inch.

Anderson and Dearborn emphasize concepts and issues important in classroom instruction--reading readiness, sex differences, scope, sequence, and method of instruction. But they also discuss research on the experimental psychology of reading--eye movements and word perception, for instance. Their book is readable and well integrated. The authors synthesize research, emphasizing content rather than scientific procedure. The methodology sections present strengths and weaknesses of several teaching methods. An extensive chapter on measurement reflects the efforts of the time to deal with assessment and evaluation of reading.

Would a purely applied approach be proper for a modern book on the psychology of reading? Here opinion may differ. One finds relatively little applied content in Gibson and Levin. They mention Tinker's work in passing, without data, and with an imprecise summary. Readability, another empirical tool useful to publishers and editors, receives less than two pages, with no details as to the meaning and use of the technique. We would have been happier to see more discussion of such practical

contributions to our understanding of reading.[5]

"Outside" versus "Inside" Books on Reading

There seem to be two kinds of books on the psychology of reading: those that remain outside the mind, and those that try to get inside. Anderson and Dearborn (1952), Tinker (1965), and Robeck and Wilson (1974) are examples of the first type. They generally build their case on descriptive data. This is a legitimate and useful treatment of problems where the best research is applied rather than theoretical, and where the need for practical guidance is great. Huey (1908) and Smith (1971) are examples of the second type, and Gibson and Levin want to be part of this group.[6] Huey discusses the thinking process in reading (cf. his discussions of letter cues and syllable stress, pp. 97-98). Many of his concepts are remarkably current: Short-term auditory memory is a more reliable repository for echoic information than the flash-in-the-pan iconic imagery of visual memory. He brings together conflicting views, using available data to guide the discussion. For instance, is visual information handled serially or in parallel? On the one hand, Cattell's introspections convinced him that the reading of the elements of a word were simultaneous. On the other hand, Zeitler worried that attention might be inadequate to detect serial input. His introspections suggested that the dominating complex (overall configuration) was available immediately, but that important literal details entered perception more slowly and perhaps successively--this analysis is fairly consistent with recent findings (Huey, 1908, pp. 62-65; Fisher, 1973; Rayner, 1975).

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[5]For a delightful example of how this task can be carried out in high style, see The Visible Word (Spencer, 1969). An up-to-date and comprehensive treatment of readability is provided by Gilliland (1972).

[6]For a contemporary treatment of word recognition that is cognitive in character, see Neisser (1967). This is by no means a book on reading, but Neisser's discussion of how the subject thinks in order to transform the visual stimulus to a "verbal sequence" (the tentative pronunciation) makes interesting reading.

Huey was acutely aware of the distinction between the stimulus and perception, an important awareness for those who would journey inside the mind. Whatever the products of perception--distinctive features, stimulus elements, hierarchical structures, gestalts--these are the work of perception; the stimulus serves only as the point of departure for mental activity. Perception tends to be veridical, to yield a "true" reading of the environment in the sense that the individual's judgments yield agreement with others. Perception also tends to find meaning, to see elements in the present situation that can be related to previous experiences. But let Huey speak:

> Perception is always a projection or localization outward of a consciousness which is aroused or suggested by the stimulations that have come inward, but which is conditioned strongly, also, from within. We have seen how, when some dominant parts of a word or sentence were exposed without the other parts, the reader would project the absent letters upon the page and would "see" them as distinctly as when they were actually before him. . . . In the case of perception it might be said that the mind furnishes the screen as well. It must be remembered that consciousness does not dwell in the retina or in retinal images. (pp. 105-106)

Gibson and Levin also aim to analyze reading as thinking. They are less successful than Huey, partly because their theory fails them. Their theory of perceptual learning says less about the process of perception than about the products of perception, the emphasis falling more upon the stimulus than upon what intervenes between stimulus and response. Consider the key points in their theory as presented in chapter 2:

1. As a result of perceptual learning, behavior adapts to the needs of the person and environmental contingencies.
2. Perceptual learning entails an active relation with the environment (reasonable, since animals, including man, do move around a lot).

3. Perceptual learning involves differentiation; with experience and feedback, finer distinctions can be made.
4. Perceptual learning involves selection; with experience certain distinctions can be ignored.

These are sensible principles, agreeable even to a behaviorist when translated into his jargon. But the theory says too little about thought processes: How is learning established; how is attention directed; how are categories of knowledge organized? The reader of the book, with a "set" to enter the cognitive domain, finds himself wading through detailed empirical statements, but not in the direct pragmatic style of Anderson and Dearborn, and company. There is too much selectivity, and too little integration.

The Theory

Gibson and Levin strike a responsive chord in us when they state their position with regard to theory: "Theories are necessary guides not only to research but also to fruitful observation of children who are learning to read. . . . theory-based observations provide the foundation for ordering the complex events that occur in the classroom" (p. 5). They promise: "Chapter 2 is a theory of perceptual learning and a demonstration of its relevance for understanding the reading process. Reading is a high-order perceptual skill, and the principles described in this chapter will be utilized throughout the book" (pp. 10-11).

Comprehensive models of "reading" are predestined to a bad end, in our opinion, because the range of phenomena is too broad, too ill defined, and too variegated. Success in other areas of psychology has come from the development of limited models to fit limited problems, where certain boundary conditions can be satisfied. So one can agree with Gibson and Levin when they say, "No single model will describe the reading process, because there are as many reading processes as there are people who read, things to be read, and goals to be served"

(p. 454).[7] Understanding reading is a grand challenge, yet it is not to be met with a grand theory (the apparent intent of chapter 2), but by formulating a series of limited understandings. Their decision is "not to design a model, but to see if we can complete our study of reading by summing what has gone before in a few concentrated generalizations" (p. 465). Unfortunately, these are vague generalizations, almost platitudes, useless to both researcher and practitioner.

Elements of the Theory of Perceptual Learning

Let us turn now to the theoretical content of the book and examine its assumptions, its predictions, and its implications for practice. The theory of perceptual learning in chapter 2 is presented as relevant to reading and the acquisition of reading skill. The assumptions are organized according to (a) what is learned, (b) how learning takes place, and (c) developmental trends in learning.

What is learned? People learn to discriminate, to differentiate, to organize the information that impinges on their senses from the environment.

> The people and objects and symbols that furnish the world differ from one another in characteristic ways that we must learn to distinguish if we are to perceive and ultimately behave adaptively. . . . Things come in finite sets, and there are feature contrasts within the set that are shared in different degrees by the members of the set. We shall refer to these as "distinctive features" which permit specification with respect to a set of alternatives. This specification is one aspect of meaning. . . . distinctive features must be invariant over a number of transformations which are irrelevant for differentiating the objects,

[7] Well, one can almost agree with the statement. Hopefully there are generalizations that hold reasonably well for certain categories of people, reading tasks, and goals.

> or symbols, such as speech or writing. (p. 15)

In short, people do not respond to the environment as an undifferentiated, blooming, buzzing confusion--they learn to distinguish the cues that mark the critical difference between one situation and another. Few psychologists disagree with this position, whether they refer to these cues as distinctive features, stimulus elements, cues, or just plain stimuli.

A second product of perceptual learning is referred to as invariants of events. We are uncertain about the meaning of this concept. It appears to treat the difference between an object and an event. An object is an entity of some sort, an event is something that happens over time. Distinctive features characterize an object, and the invariants of an event serve a similar purpose for characterizing the event. But these invariants also play a role in learning distinctive features: "It seems very likely that a child's attempts at making letters himself--a highly observable and interesting event--contributes greatly to his learning the critical features that distinguish one letter from another" (p. 21).

The third product of perceptual learning is the higher-order variable, which includes relations among distinctive features and/or invariants of events. "Relations can be thought of as subordinate or embedded, so there are two ways of thinking about structure: the whole formed by the relations of subordinate features, or the part in its relation to the whole" (p. 21).

It is not altogether clear that the second and third categories of learning products add much to the first one. The concept of a distinctive feature is quite general and appears to subsume the other two classes. The latter are described only vaguely. Examples of higher-order variables are provided but do not help: "A man belongs to a set of animate things" (p. 21). Or later: "Written words, like spoken ones, are of course combined into still higher-order structures, like phrases and sentences and paragraphs. Higher-order structures, once detected by the learner, provide him with larger units of information that he may be able to process as wholes or 'chunks', a very great cognitive economy" (p. 23). We have no quarrel with the general sense of this proposition--most present-day cognitive psychologists surely accept it. But is the

theoretician to account for the principles and processes for organizing a paragraph in the same way that he describes how a word is recognized and translated into meaning? This seems unlikely. The effort to stretch one theoretical proposition over a broad range of phenomena may account for the relatively short shrift given in this book to areas like paragraph comprehension. This topic is mentioned, but only briefly, and with no real attention to the substantial advances during the past five to ten years in this country and Europe (Norman & Rumelhart, 1975; Crothers, 1975; Grimes, 1975; Kintsch, 1974; Petöfi & Reiser, 1973).

The next theoretical question considered in chapter 2 is: "How does learning take place?" The first answer is negative: Perceptual learning does not occur as stimulus-response associations. Just which version of this old straw horse is being beaten is not obvious, but it does appear that "stimulus-response behaviorism" is one of the "bad guys."

The second answer is more explicit: Distinctive features are acquired by a process of abstraction. How this happens is not spelled out--the process is something like concept learning, except that in the former a perceived contrast rather than an idea is abstracted. Presumably some kind of feedback is required, but that is not mentioned. It does help if the contrast is emphasized during training. The process also involves "learning to ignore irrelevant information" (p. 26). Unfortunately, "results of the research at present are not very consistent, tending to vary with the task and the age range considered" (p. 26).

Perceptual learning, they go on to say, does not require externally applied reinforcement, and indeed cannot depend on it "because an external agent cannot have knowledge of the learner's knowledge until the learner is ready to inform him of it--and then he has learned" (p. 33). This is an unusual state of affairs indeed. For all kinds of learning there is the problem of finding performance measures that adequately reflect the learner's state of knowledge. In perception, the measurement problem is a bit stickier than elsewhere. Psychologists usually see this difficulty as one of the challenges of their science but not as an impenetrable barrier. For the classroom teacher to be told that there is no satisfactory way to monitor progress in learning is distressing indeed.

One can agree with Gibson and Levin that the student is better directed when the motivation for a task suits personal goals and interests, rather than depending upon an M & M or a token. Yet there still is value in praise, advantage in feedback, and guidance in modeling. The researcher or teacher can arrange conditions to gain reliable information about the development of knowledge, and may well have the responsibility for doing this. Many students come to the primary classroom with only the vaguest ideas about reading; many enter later grades having experienced failure in reading. The teacher who must deal with these students senses a hollow ring to such words as: "There is a natural reward for reading. One finds out something. Getting wanted information from the marks on the page is an obvious motivation for learning to read, and every effort should be made to encourage and take advantage of it" (pp. 35-36). Teachers are well advised to promote any natural interest and enthusiasm for reading and to rejoice when the student possesses this attitude. But they must also be prepared to meet the needs of students who enter with a quite different set; developing motivation and positive expectations about reading is a major task for the teacher.

We have drifted from theory, it may seem, and entered the realm of practice. But this is the path of the chapter, and it takes us next to the matter of developmental trends. Gibson and Levin stress greater differentiation with increasing age, greater attention to what is relevant and less to what is irrelevant, and improved efficiency in the coding and organization of information. These assumptions (actually empirical generalizations) are consistent with the proposition that the student learns as he grows older.

It is hard to see predictions springing from Gibson and Levin's theory of perceptual learning, aside from those that are part of the generalizations themselves. It is equally hard to imagine data that refute the theory. Perhaps such requests demand too much. Theory in psychology is often a heuristic intended to organize diverse facts and ideas but not intended to predict, in any strong sense. But it is also hard to see the heuristic value of this theory. The major generalizations are so broad and diffuse that few would disagree with them. They help us organize only well-known facts. The same remarks hold for the characterization of skilled

reading as an adaptive process (p. 454). Although not intended as a theory or a model, even as a set of principles, this characterization does not come to grips with the research evidence: The reader attends selectively to features in word perception; the reader engages active strategies according to his needs and purposes; the reader seeks economy in attending and organizing. Who would disagree? But how do we apply these principles in a nontrivial way?

The Potential for Theory in Reading

What are the possibilities for theory and model development in the field of reading? Perhaps Gibson and Levin have done the best that is possible. We think not. Instead we must agree with Suppes (1974) that research on reading (and on education more generally) has failed to make reasonable use of the theoretical tools presently at our disposal. It is impossible to do more than suggest some possibilities here; the full development of this point would fill a book.

We distinguish between formal models and heuristic models--we hesitate to use "theory" because the term implies for us a breadth of coverage that we cannot yet aspire to. Formal models are built upon explicit and precisely stated assumptions and engage mechanisms for generating predictions of a nontrivial sort. These models are best suited to situations of a circumscribed, well-bounded nature. A good example of such a class of models are those that derive from stimulus-sampling theory (Estes, 1959) for the learning of simple associations. Another example comes from the memory models that have been applied with success to numerous phenomena in this area by Atkinson and Shiffrin (1968), among others. Estes (1972) has developed formal mathematical models for word identification; Bower's (1967) multicomponent models for memory and perception are well suited to testing the concept of distinctive features. These developments in stochastic models have been well documented over the past 25 years (Luce, Bush, & Galanter, 1963).

A related class of models comes from the general additive model and the associated analysis-of-variance and multiple-regression techniques. Sternberg (1969), Anderson (1971), Loftus and Suppes (1972), and Calfee

(1975d) have demonstrated the application of these simple but powerful models to the theoretical investigation of cognitive processes. Finally, for problems that are overly complex or too poorly understood to handle analytically, the computer is useful as a device for exploring the consequence of formal or semiformal models (e.g., Chase, 1973; Newell & Simon, 1972).

It is rather amazing that so little use has been made of this rich array of theoretical models. Studies continue to report average learning curves, total errors, or trials to criterion as primary data. Twenty years ago it was shown that such analyses are totally worthless as indicators of the learning process, and alternative methods of analysis were worked out in detail (Suppes & Ginsberg, 1963). These techniques are largely model-free and apply readily to situations other than the stimulus-response association paradigm from which they were originally derived (Suppes, 1966). The theoretical ideas have been used to optimize the learning process, with substantial improvement in learning rate; one of the appplications has been to beginning reading (Atkinson & Paulson, 1972; Atkinson, 1974). Gibson and Levin make but passing mention (pp. 318-319) of this development, which has potential application to the classroom as well as to computer-assisted instruction (Calfee, 1970).

Heuristic models are designed to be taken "less seriously" than formal models, but they are useful nonetheless. The models in chapter 12 fall within this category. Mackworth's (1971) model of skilled reading is comprehensive and complex, and it makes good use of the ideas available when it was created. For the teacher or researcher unfamiliar with contemporary notions of information-processing, such as transfer and recoding of information through the action of perception and memory, the model presents these ideas in a compact and informative manner. Gough's (1972) model handles "one second of reading." Complex, clever, and provocative, it leads step-by-step through the decoding of a single word, in context, by a skilled reader. Built into the model are Gough's generalizations from available data--for instance, translation of a word entails serial identification of some, if not all, letters in a word. One may argue, as Gibson and Levin do, that letters are read certainly not "in strictly serial fashion, probably not always from left to right, and possibly not as single units but as spelling

patterns. None of these amendments, however, challenges the overall structure of Gough's model. The model does not give complete understanding of the reading process--for instance, it does not explain how the reader comprehends a paragraph. But that is not its purpose. Gibson and Levin fault the model because, among other things, "it cannot handle the word superiority effect [a single letter is identified more accurately when it is in a word than when it is presented alone] which has now been thoroughly documented" (p. 449). (The word-superiority effect was "disdocumented" in 1973, as we will see in the next section.)

Whatever the merits and weaknesses of a particular heuristic model (we happen to think that Gough's model is clever, though capable of neither proof nor disproof), it holds the field until it is replaced by better ones. A "better one" is easy to spot--it is more comprehensive, more parsimonious, more precise, and more accurate in its predictions.

Specific Analysis of Distinctive Features in Reading

A particularly rich application of heuristic models to the understanding of reading is found in Smith (1971). Here is a sample:

> What are the features of words? They obviously must include the features of letters, because words are made up of letters. The arrays of marks on the printed page that can be read as words can also be distinguished as sequences of letters. The 'distinctive features' of letters, those features that constitute a significant difference between one configuration and another, must therefore be distinctive features of words. For example, whatever permits the visual system to distinguish between h and n must also permit it to distinguish between hot and not. And precisely the same mechanism that distinguishes between h and n will accomplish the discrimination between hot and not. (pp. 128-129)

> A distinctive feature . . . is an element of a stimulus configuration that constitutes a "significant difference"--that enables a perceiver to eliminate some of the alternative categories to which the configuration might be allocated. In the case of letters the number of alternative categories is 26; in the case of words, just to have a figure, let us say a skilled reader must have about 50,000.
>
> How many feature tests would be required to discriminate sufficient significant differences among visual configurations to permit their allocation to just one of 50,000 categories? The formal information theoretical calculation shows that . . . fifteen or sixteen binary feature tests would be enough ($2^{15} = 32,768$; $2^{16} = 64,536$) particularly if the word length could be taken into account for an initial exclusion of unlikely alternatives.
>
> Of course, many more than 15 tests could be made on most words. If we assume that there are ten distinctive features for every letter, and five or six constitute a criterial set, a five-letter word such as horse would contain 50 distinctive features. . . . If 50 features are available in a five-letter word and only 15 are required for its identification, there is a good deal of redundancy present. (p. 132)

It seems plausible that the skilled reader uses selected features of the printed stimulus to identify letters, words, and perhaps phrases and sentences. Some of these cues are probably configurational. But what are the cues? What is the nature of the configurations? How does the reader shift from one type font, or case, to another? How does the process depend on the reader's purpose and strategy; on the nature of the material being read; on the reader's experience and training?

In the passages quoted and the surrounding text, Smith does not quite propose a formal model, but his ideas

contain enough detail that one can generate explicit propositions from them. For instance, Table 1 illustrates a feature analysis consistent with Smith's model.

Table 1

Distinctive Feature Analysis of Words in Reading Consistent with Smith's Model (1971)

Word characteristic tested	Outcome	Implication
Length		
Short (five or fewer letters) vs. long	Short	More than half the words in Webster's are ruled out.
First letter		
Straight lines only vs. some curves	Straight only	AEFHIKLMNTVWXYZ
*Slanted vs. | - only	| - only	EFHILT
*Simple (two lines or less) or complex	Complex	EFH
* = or ||	||	H
Last letter		
Straight lines only vs. some curves	Straight	AEFHIKLMNTWXYZ
*E vs. others	E	E
Second letter		
*Vowel with straight or curved lines	Curved	O

Note. Where * appears, the question is conditional. The next to last question makes sense on the assumption that E is the most likely final letter consisting of straight lines only.

After the last question, the word has the form #0#E, where # marks zero, one, or two letters. Fewer than 10 words in the English language fit this pattern, so three more, well-chosen questions suffice to specify the word. We have assumed nothing about the context; the knowledge that the word is in a cowboy story makes certain words more likely than others.

Smith has tried to think through an admittedly limited situation--identification of a single word with no context. His reader applies a series of independent binary tests to the word, each test chosen to eliminate half the remaining alternatives. With 15 tests the reader can translate a lexicon of more than 50,000 words.

We can generate hypotheses about the form of these tests--hypotheses capable of experimental test. We can explore other facets of the model: Are the tests made serially or in parallel? What if the tests are not fully independent? (Bower's 1967 multicomponent model explores this question.) How does context allow more efficient selection of criterial features?

Understanding the reading process requires the fullest use of our analytic skills as psychologists. The task calls for precision in formulating the operation of the underlying cognitive processes. Estes's (1975) paper provides a good example of the level of detail needed. He was interested in a fairly well-defined question: Why is a letter easier to identify when it is embedded in a meaningful word? In his analysis he carefully teased apart the several processes--perception, memory, and decision making--and examined their contributions to word and letter identification.

Gibson and Levin review the research on this question (pp. 209ff.) but leave the issues unresolved (p. 211). A key finding turns up almost three hundred pages later (p. 479); Thompson and Massaro (1973) show that the "word-superiority" effect disappears when the subject sees the letter alternatives before presentation of the word--with pre-cueing, isolated letters are more easily identified than letters in words. Bjork and Estes (1973) report a similar result, demonstrating that the word-superiority effect does not hold generally.

But back to Estes's theoretical analysis: What leads to the word-superiority effect when it occurs? How does the word facilitate letter identification when alternatives are not known in advance? Several

possibilities were ruled out by earlier research. It was not pronounceability; nor was it sequential redundancy. It might be what Smith and Haviland (1972) called "unitization," by which they mean that the perceptual chunk for words is larger than for nonwords--but this gives no understanding of the mechanism.

By hypothesizing specific features, Estes came up with an answer--the letter-position cue. When a laboratory subject sees a word, briefly flashed and fuzzy, he is uncertain about the location of letter features. He saw a curved line, but was it in the second or third position of a four-letter word? With a real word, the sequential dependencies in the letters help the subject at the time of testing to reconstruct the location of the nontarget letter alternatives. Suppose the subject saw a curved segment somewhere in the middle of the word which he knows contained the letters P, A and T. The test alternatives are --S- and --N-. Knowing that the stimulus was a real word solves the reader's problem. If P were in the second position, then he might have seen APST or APNT. The curve might have been from the P. But neither of these are real words. PAST and PANT are. If he saw a curve in the middle, S must be the third letter, because the only other letter with a curve (P) must be in the first position. With a nonword, he lacks this aid. Features from various letters tend to float from one position to another, leading to errors. Estes, by specifying relevant categories of features, advanced our understanding of this problem. The word-superiority effect seemed a "magical" happening in word perception--it now appears that perception of isolated words is based largely on identification of letters supported by the subject's knowledge of sequential dependencies between letters in English.

To be sure, missing from Estes's account (as from most theoretical and empirical accounts of word identification) is any reference to the individual differences due to training, expectation, or preference. Students read differently depending on how they are taught--on this point common sense is supported by data (Barr, 1974). Moreover, words are different in ways that influence perception (Clark, 1973). These differences are generally treated by the psychologist as "noise" and irritating as well. These variations have seldom been adequately well controlled in experiments on word

perception. Perhaps for this reason the literature on word recognition yields few trustworthy generalizations--the investigator can obtain any results he desires by proper selection of subjects and words. Until theory guides us to more adequate characterization of subjects and of linguistic materials, research will be plagued by unreplicable and inconsistent results. It is too big a charge to ask that Gibson and Levin should have solved this problem, but one could hope that they should have addressed it more forcefully.

The Research

Criteria for a Review of the Literature

What does one expect from a review of the literature like The Psychology of Reading? First, one expects the review to bring into bold relief the pertinent questions before the field. Second, one expects a comprehensive accounting of the available research--theory, empirical studies, and interpretation. In the psychology of reading, empirical investigations predominate. For these, one expects a description of important procedural and methodological paradigms, with enough detail so that the nonspecialist can understand a typical experiment. There should be a critique of significant studies: Which ones are exemplary, and why? What is wrong with these that are less adequate? What kind of data do typical investigations yield? What can be gleaned from the collective studies, taking both good and bad into account?

Finally, for each major question one expects an integrative summary: What is the current status of the problem? How can available knowledge on the problem be put into use? What needs to be done in the way of research and theory?

It is a big order, perhaps, but a reasonable one. The researcher can find in various compilations (the ERIC system, summaries in the Reading Research Quarterly, and so on) an abundance of papers on reading research, but what is needed is evaluation: setting criteria for sorting and identifying worthwhile research and tying the facts together. Any such effort is a risk, for today's standards may change by tomorrow, and the tie that binds for the present moment may later prove a snarled knot.

But the reviewer takes this risk; otherwise he serves only as a compiler.

How well do Gibson and Levin meet this challenge? They do raise many provocative questions. Whether these are the most useful and relevant will be discussed as we go along. The authors do seem often to present broad, vague propositions that require more analysis.

Their coverage of the literature is extensive, but its comprehensiveness and representativeness can be questioned. The emphasis is on recent studies. Of the approximately 850 references in Gibson and Levin, somewhat more than a third are from 1970 to 1973, about 40% are from 1960 to 1969, and the remaining 25% are prior to 1960. Many references are from nonarchival sources (about 15%), so the reader who wishes to check an original will frequently have trouble finding it. Work from the Cornell laboratories is disproportionately represented; more than 7% of the references are from Gibson, Levin, or their students. This percentage undoubtedly reflects the activity of the Cornell group, but it also appears that some groups are not so well represented.

The discussion of paradigms is spotty. A paradigm is a model or pattern, and a research paradigm is a "pattern" for carrying out an investigation of a class of problems. Some research tasks are discussed in concrete detail, others are left unexplained, without any obvious rationale for one or the other course. There is little effort at critique or evaluation of paradigms. Important distinctions are blurred. For instance, in research on perception and memory, the subject faces very different cognitive demands in a word perception task (e.g., 191ff.) when he is asked to recognize the "correct answer" from a set of alternatives than when he is asked to reproduce the answer on his own. This is comparable to the difference between a multiple-choice test and an essay examination. These two tasks yield measures of performance that are correlated from student to student, but there is now substantial evidence (Kintsch, 1970, chap. 5) that different cognitive processes are called into play by these two testing procedures. Unfortunately, one can read the series of studies on the effect of meaning in word perception (chapter 7), unaware that the task is changing markedly from study to study.

The authors' selection of studies for emphasis seems idiosyncratic. A study is introduced to make a point rather than because its content or quality merits special attention, or because its control and coverage justify strong conclusions. The criteria for accepting or rejecting the conclusions of empirical studies are not clear; a given standard is applied in some cases and not in others. As an example, a study by Rubenstein, Lewis, and Rubenstein (1971) is dismissed (p. 206) by a footnote mentioning H. Clark's (1973) language-as-a-fixed-effect fallacy. Clark's point is that the investigator in language research should measure the effects of variation in the materials other than those of special interest to him. The investigator should not propose a hypothesis and then pick out a set of materials that promote the hypothesis; he should provide evidence that the hypothesis holds for a reasonable range of materials. This standard is one with which we are in complete agreement (Cronbach, Glaser, Nanda, & Rajaratnam, 1972, discuss the general problem more fully). Clark used the Rubenstein study as as example, which is fair enough, but if Gibson and Levin wish to apply this standard to one study, then it should be applied to all. If they were to do so, they would reject many studies in addition to Rubenstein's. In fact, the merit of Rubenstein's research was that it was sufficiently well controlled to allow a test of generalizability and, hence, is probably more trustworthy than most. This entire issue is likely to be missed by most readers because the discussion is so limited.

More generally, Gibson and Levin vary as to the detail reported on a given topic. Data are comparatively rare in this book. There is a tendency to report "more" and "less" when numbers would do a better job in the same space. Significance tests are used when amount of variance or actual magnitude of effect would give a more complete picture.

Finally, the reader who hopes for integration will be left unsatisfied. This is the most difficult task, and given the present state of affairs in theory, perhaps one should not expect much. But in too many instances, papers bearing on a common theme are scattered throughout the book, and conclusions do not spring from the data.

For integration, Gibson and Levin resort to a kind of Aristotelian nominalism. For instance, one may or may not agree with them as to the utility of the concept of

distinctive features. Its applicability to certain limited questions is well established, but at present the concept is too ambiguous to serve for explanation and integration. Thus, the following integrative summary of word recognition research leaves us with an empty feeling, with a need to go back through the chapter and try ourselves to put the research together in a way that has more meaning and coherence.

> A word was defined as a composite of features, classified as graphic, orthographic, phonological, semantic, and syntactic. Another feature of a word which may be considered as having an objective aspect (but also a subjective one) is its frequency of occurrence in the language (paralleled, to some extent at least, by its familiarity to the reader). There are also subjective variables, internal and individual rather than belonging to the word, that affect how easily a word or what word is perceived.
>
> Any or all of these variables might affect a word's recognizability. Evidence for the effectiveness or noneffectiveness of all of them was considered. Features of a word may be given different priorities, depending on the task or on a subject's expectations. Indeed the subjective variables interact with those in the word by setting priorities for extraction of information, and often lead to errors because other informational features go unexplained. (p. 223)

What we have here is a list of names, recapitulating the key points of the earlier discussion, but without the structural ties that lend meaning to the terms.

The Cromer Incident

One expects from a reviewer a careful and critical analysis of individual research studies. This builds a firm foundation. Others who read the review and shape

their thoughts from it are twice removed from the data--the reviewer has to be able to trust the original author's report, and the reader has to be able to trust the reviewer's examination and evaluation.

How well do Gibson and Levin carry out this task? Our impression is that their examination is often too cursory. One illustration will be presented, chosen not entirely at random, but neither as a special case. If this instance is in any way typical, as we fear it may be, then one should be cautious in accepting the empirical generalizations in this book.

For many years I (Calfee) have heard about students whose decoding skills are well developed but who have trouble understanding what they read. Indeed, the claim has been made that the decoding "problem" has been solved and that the major task left to reading instruction in American schools is teaching comprehension skills. Some students may fit the pattern described, but I have yet to encounter a student where the evidence was persuasive that he could decode fluently but not comprehend. I have sought such students both in this country and in others where the letter-sound patterns were more regular than English. In my experience, the student who has difficulty understanding what he "reads" also has trouble translating from print to the spoken language. Decoding skills are often manifestly weak, or the student lacks mastery. Given enough time, the student may be able to sound out a single word. But given the more demanding task of reading connected text, he resorts to guessing from minimal cues such as the initial letter, context, or the like. This is my experience, as I say. But many people of knowledge and judgment have told me that the syndrome exists. So it is with more than passing interest that I read in Gibson and Levin:

> ther studies attest to the fact that there are poor readers who are perfectly good decoders." They have learned the mechanical aspects of the task but are apparently processing the text word by word, not using contextual semantic relations and syntactic information. Cromer (1970) identifies one form of reading difficulty as failure to organize input of reading material into meaningful units. He

separated a group of poor readers in a junior college into a "difference" group and a "deficit" group. [One might ask whether this problem is best investigated with college students as subjects.] The difference group had adequate intelligence and language and vocabulary skills but had difficulty comprehending, presumably because they were reading word by word rather than taking in phrases and larger units. The deficit group was poor in comprehension because of a specific deficiency in vocabulary. Cromer conducted an experiment with three groups of subjects, a difference group, a deficit group, and a group of good readers. A set of stories, each with a multiple-choice comprehension test, was chosen and presented in four different modes:

1. Regular sentences — The cow jumped over the moon
2. Single words — The / cow / jumped / over / the / moon
3. Phrases — The cow jumped over the moon
4. Fragmented groupings — The cow jumped over the moon

It was reasoned that phrase groupings would facilitate comprehension for the poor readers in the difference group but not for the poor readers in the deficit group or for the good readers (who presumably already organized the text in meaningful units). When the material was presented word by word, the deficit poor readers and the good readers were expected to comprehend less well, while the difference group was not expected to be affected, since they were assumed to read this way already. (pp. 382-384)

The study turned out as expected:

> When the number of questions answered correctly was compared for the four modes of presentation and the three groups of subjects, the poor readers overall answered fewer questions correctly than did the good readers. But the difference group of poor readers comprehended better on the phrase mode than they did on the other three modes, performing just as well as the good readers on that mode (good readers were best and equally good on sentences and phrases). The deficit poor readers, relative to their own low performance on regular sentence presentation, answered the most questions correctly on the single-word mode and were not helped by phrasing. Thus the difference poor readers, who were hypothesized to read poorly simply because they did not organize what they read for comprehension, were helped by presentation with meaningful grouping. Their performance was similar with regular sentence presentation and single-word presentation, lending credence to the notion that they typically read word by word.
>
> It should be noted that these three groups of subjects did not differ on simple word identification (reading aloud the words in the single word presentation). They all had adequate word-naming skills. However, the deficit group took considerably longer to read the material aloud. This fact suggests that they were not only having trouble at the comprehension level but had not learned to use all the intraword redundancy either. This lack would contribute to a failure to deal adequately with units organized by meaning, simply by slowing them down. While intraword conditional redundancies must be mastered for skilled reading, this study implies that teaching solely by single word identification could be dangerous and lead

> to habits of reading word by word rather than by phrases and units grouped by meaning and linguistic structure. The multilevel approach again seems justified. (p. 384)

This extensive quotation is placed here because the study is often referenced, is complex, bears careful examination, is noteworthy for its implications, and, as you can see, because Gibson and Levin allocate a substantial amount of space to it. From interest more than skepticism, we decided to examine the Cromer paper ourselves. Here are the results.

First we need to examine the selection of four groups of readers, because this is central to the study. Scores were available on the Vocabulary and Comprehension subtests of The Cooperative English Test of Reading Comprehension (ETS, 1960).[8] One would expect these two subtests to be closely correlated. If so, the situation prior to selection should be something like that shown as Step 1 in Figure 1. The solid regression line represents the predicted relation between the two subtest scores. The population of college students is divided into poor readers and good readers by drawing a line at the 25th percentile on the Comprehension axis. Next, poor readers are divided into those whose vocabulary scores are also low and those with relatively high vocabulary scores (Step 2). The first group, the "Deficit" students, reflects a typical, if regrettable, state of affairs; they do poorly in both comprehension and vocabulary. The second group is labeled the "Difference" group. Such students are fairly hard to find, given the close relation between comprehension and vocabulary. Because they are not typical, one expects their scores to show the "regression to the mean" effect; if they are retested, either their comprehension score will improve, their vocabulary score will decline, or both. The new scores will be closer to the regression line. These students may really be "different," but there is also a good chance that the investigator is capitalizing on unusually wide swings in the error of measurement.

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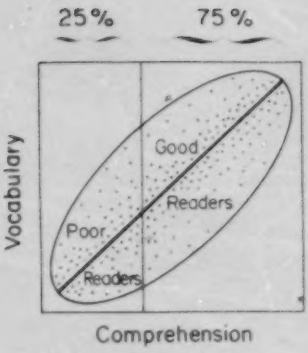
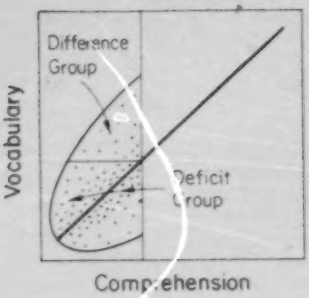
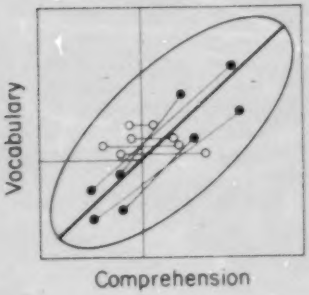
[8] The Vocabulary Subtest is a four-alternative multiple-choice test, in which a key word has to be matched with a synonym among the alternatives. This is not really a test of decoding skills.



Step 1: Select as poor readers those in the lower 25% on comprehension.



Step 2: Divide the poor readers into those with poor vocabulary scores (Deficit Group) and those with relatively high vocabulary scores (Difference Group).



Step 3: Select 16 subjects from Deficit and 16 from good readers as Deficit-Controls. Select 16 subjects from Difference and find 16 good readers with same vocabulary score as Difference-Controls.

Figure 1 - Diagram showing steps in subject selection for Cromer (1970) study.

After the two groups of poor readers were selected, each was matched for control comparisons with a good reader as shown in Step 3 of the figure. Each Deficit reader was matched to a good reader with a higher (generally a much higher) vocabulary score.[9] This was easy to do. Each Difference reader was matched to a good reader with the same vocabulary score. This is hard to do. There were not many Difference readers to begin with, and there were relatively few good readers with low vocabulary scores. Matched pairs can be found, given a large enough population for selection--and they were found. The relevant statistics are shown in Table 2. The data permit various comparisons, but interpretation is clouded by the fact that the Difference and Difference-control groups were not selected in truly random fashion. One wonders what their performance would be on a retest. In fact, their reading comprehension was retested as part of the experimental task.

Table 2

Statistics from Original Study by Cromer (1970): Deficit and Difference Categories

Group	IQ	Vocabulary	Comprehension
Deficit (Poor comprehension)	110[a] (104-121)	154 (144-162)	148 (142-151)
Deficit-control (Good comprehension)	111 (100-121)	166 (157-174)	165 (160-179)
Difference (Poor comprehension)	111 (102-131)	159 (151-166)	146 (136-151)
Difference-control (Good comprehension)	111 (102-127)	159 (153-164)	164 (160-172)

[a]The average and the range in parentheses.

[9]The subjects were also matched in IQ, with effects on the randomization that are hard to determine, since no information is available on the correlation between the various measures.

Let us suppose, for sake of argument, that the selection process was biased, and that no real difference existed between the Difference and Difference-control students; we have 16 pairs of students, and within each pair one student is arbitrarily labeled "good" and the other "bad." These two students are on opposite sides of the regression line, and at some distance (Figure 1, Step 3). The expectation is that on a retest their scores will snap back toward that line, the implication being that in about half of the 16 pairs the good reader will do more poorly on comprehension than his partner. We quote from Cromer:

> After the experiment had been completed and the data analyzed, all subject pairs were compared on their [post-test] comprehension scores on the regular sentence condition. It was then discovered that six of the Difference pairs and one of the Deficit pairs were reversed, that is, the good reader had a lower score on the regular sentence condition than did his matched pair who had been defined as a poor reader. It was decided to reanalyze the data by switching these (reversed) subject pairs so that the effect of these subjects on the results could be assessed. (p. 473)

Cromer's "switchers" suggest the following interpretation of the selection process: The Deficit and Deficit-controls are poor and good readers, respectively. The Difference and Difference-controls are two groups of moderately poor readers, not different from one another.

In any event, this interpretation did not occur to Cromer, (nor apparently to Gibson and Levin). Let us see what happened next. The study was analyzed as two groups (Deficit and Difference) of 16 pairs of students--a good and a poor reader in each pair. The various measures were all converted to standard score form, which makes it impossible to determine actual performance levels since means and standard deviations are not reported. The number of correct answers on a comprehension test after silent reading was the first measure discussed. These data show convincingly, if unsurprisingly, that good readers do better than poor readers. This result is

almost entirely due to the different performances of the Deficit and Deficit-controls, whose standard scores are -.48 and +.42, respectively. The Difference and Difference-controls perform about equally (scores of -.11 and +.05), as predicted if the selection process operated in the manner described earlier.

Cromer reanalyzed the results using the revised pairings, thereby capitalizing on a different distribution of chance errors of measurement than those used in the original selection. He found a significant levels-by-groups-by-mode interaction in this new analysis, which he proceeded to discuss in some detail (Table 3). His main point was that the unusually high performance of the Difference subjects in reading phrases proved his thesis that they were in fact "different." Perhaps, but the careful reader has to find and correct a number of mistakes in the paper before being assured that any conclusion is safe (see notes in Table 3). But is the interaction really significant? In a repeated-measures analysis of variance, certain precautions must be taken. When the same subject is tested repeatedly, successive observations tend to be correlated. This can affect the distribution of the F-ratio so that the effects seem to be more "statistically significant" than they really are. An adjustment known as the Geisser-Greenhouse correction is usually recommended (Winer, 1971, p. 523). If the correction is applied in this study, the three-way interaction is not significant at the conventional (.05) level. This suggests that the pattern in Table 3 is not altogether trustworthy in its detail and merits cautious discussion at best. A conservative investigator would replicate the study.

Now, back to the question posed originally--are there some students who can decode fluently but cannot understand what they read? Cromer asked his students to read aloud and recorded both time and accuracy measures. Overall, poor readers made more oral reading errors than did good readers--the Deficit and the Difference groups performed about the same. When the passages were arranged as a horizontal list of single words, all groups did equally well (everyone did pretty well in correctly decoding single words), but--and here's the catch--"poor readers as a group took more time to do the oral reading task than did the good readers, and this effect was evident on each of the four reading

Table 3

Standardized Comprehension/Correct Scores for Levels-by-Groups-by-Mode Interaction, Cromer Study (1970)

Levels and groups	Mode				Average
	Words	Fragments	Phrases	Sentences	
Deficit (Poor comprehension)	-.04	-.35	-.57	-.75	-.43
Deficit-control (Good comprehension)	.62[a]	.42	.58	.33	.49
Difference (Poor comprehension)	-.59	-.44	.48	-.77	-.31
Difference-control (Good comprehension)	-.09	.00	.36	.71[b]	.25

[a]This value is incorrectly plotted as .72 in Cromer's Figure 1.

[b]This value is incorrectly reported as -.71 in the text of Cromer's paper.

conditions . . . single words took the most time (for all groups)" (p. 479). These results apply for the groups as originally constituted. When the subjects were reclassified, the Deficit readers took longer to read the single words than the other three groups, whose performance is described as comparable; no actual data are reported. Mastery of decoding skills requires both speed and accuracy, which is why the time scores are relevant.

What can be safely concluded from this study? Neither grouping of the Difference subjects seems trustworthy to us; it is especially distressing that one grouping supports one position (the Difference group lacks adequate decoding skills) and the other grouping the opposite position (the Difference group has adequate decoding skills). Hence our reluctance to accept Gibson and Levin's conclusion quoted earlier that "teaching solely by single word identification could be dangerous." The statement may or may not be true; it certainly does not follow from this study.

Cognition, Language and Reading

Gibson and Levin allocate a substantial amount of space to a discussion of current psychological research on thinking and language, and the relation of these topics to reading. In the section that follows, we will examine these matters.

Thinking and Reading

Chapter 3 deals with thinking in relation to reading, with emphasis on the development of thinking skills. The thesis of this chapter is that reading is first and foremost a cognitive task, and so understanding of the techniques for the study of thinking should transfer readily to understanding of reading. Gibson and Levin select five cognitive tasks for examination:

Focusing attention in a simple decision,

Efficiency of search,

Discovery and use of natural structure,

Problem-solving with verbal material, and

Development of strategies for remembering.

A section is devoted to each of the five tasks. There is a question or introduction to the problem, one or two research studies, and then a summary of the implications for reading.

If the purpose of this chapter is to lead the reader to think about cognitive processes in reading, success is limited. The selection of studies seems arbitrary, their relation to reading tangential, and the generalizations so broad as to be of limited applicability. For instance, after discussing a study on anagram solving, the conclusion is that "the long process of becoming literate involves problem-solving strategies at various levels that do not come all at once. Perhaps they can be fostered by providing the relevant information at the right time" (p. 57). Surely cognitive psychologists have knowledge of greater value to share with teachers; for instance, the

research of the past decade on the development of memory has considerable applicability to the teaching of reading (Calfee, 1975c).

Also in chapter 3, Gibson and Levin present a well-written section on conditions that promote transfer. The teacher should stress transferable principles, train the student to look for transfer, and provide sufficient variability during training for motivation to, and opportunity for, transfer. The research by Levin and his colleagues on training for diversity is especially pertinent to this issue. For some reason there is no reference to this research in the later chapter on beginning to read. Also missing is any note of the studies by Williams (1968) and Ackerman (1973) that support Levin's findings and have the advantage of being in the archival literature.

Language and Language Development

Chapter 4, "Linguistic Concepts Necessary to Study Reading," is brief and off the mark. Gibson and Levin emphasize the topics of phrase structure and transformational grammar and give relatively less attention to phonology and semantics. Using the criterion of "relevance to reading," these priorities might have been reversed.

In phonology, the close link between articulation and production not only provides an easy route for understanding phonetics and speech variations, but also provides the problem reader with an awareness of phonological concepts (Lindamood & Lindamood, 1969). The definition of syllable is another pertinent problem from linguistics and psychology which bears on reading. Treatments of this topic are few and generally misguided, as Wardhaugh (1969) notes (p. 90).[10] (A useful account is Shuy, 1973; also in Ruddell, 1974.) The work on vocalic center groups is much too quickly dismissed (p. 91). Hansen and Rogers' (1968) algorithm for handling polysyllabic words is one of the few systematic attempts

[10] In the case of passing mention of work discussed in Gibson and Levin, we have generally not repeated the reference in this review; for instance, the reader might consult Gibson and Levin for the Wardhaugh reference.

to understand how such patterns are decoded.[11]

Gibson and Levin spend three pages on case grammar, which a number of linguists and psychologists have found a promising alternative to transformational grammar. Grimes (1975) has extended the propositions of case grammar to the treatment of discourse beyond the word and the sentence to the paragraph. Certainly for those interested in comprehension of connected prose, these developments represent the most exciting happening on the linguistic scene. Research by groups at the University of California at San Diego (Norman & Rumelhart, 1975), at Colorado (Crothers, 1972; Kintsch, 1974), at Berkeley (Frederiksen, 1972), at Cornell (Grimes, 1975), and in Europe (Petöfi & Rieser, 1973; Van Dijk, 1972) attest to widespread interest by psychologists, linguists, and educators in this approach.

Semantics and syntax are linked in case and text grammars. As in the archaic practice of sentence diagramming, terms like "the subject of the sentence," "the direct object," and "a prepositional phrase of location" have central roles. The grammar links these units with the core of the sentence, the primary verb. Throughout, syntax serves meaning:

> The case notions comprise a set of universal, presumably innate concepts which identify certain types of judgments human beings are capable of making about the events that are going on around them, judgments about such matters as who did it, who it happened to, and what got changed. (Fillmore, 1968, p. 24)

Case grammars are limited to the phrasing of single sentences; text grammars handle paragraphs, concatenations of sentences. Here the issues become those of reference, paraphrase, structure, and organization. One of the more

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[11] Gibson and Levin do not think that Hansen and Rodgers are right about the order in which the elements in a word are processed. Actually, the argument does not rest much on the assumption of order. The Smith and Spoehr (1973) data supporting the algorithm are not to be discarded lightly; the study was well controlled and the outcome fairly clear.

seminal concepts comes from Chafe's (1972) notion of "foregrounding"; each sentence in a paragraph is designed to say something new about something old. Foregrounding has generated considerable linguistic research, as well as a number of innovative studies in psycholinguistics (Bransford & McCarrell, 1974). Gibson and Levin discuss this topic several chapters later (pp. 394, 417), but the linguistic foundation in chapter 4 is scarcely adequate to support the subsequent discussion. The challenge they see facing researchers in the immediate future is "the need for a theory of comprehension in order to specify reasonable units that give us a tool to measure comprehension" (p. 400). Case and text grammars might provide a reasonable foundation for such a theory.

Chapter 5 on "Language Development" is much longer than chapter 4. This is somewhat surprising since most children are linguistically mature by the time they enter primary school.

> Children, it is often asserted, are linguistically mature by the time they start to learn to read. They have mastered the phonological system of their language, except perhaps for a few hard-to-articulate sounds. They can say and understand all of the sentences which the grammar of their language allows, except for rare and complicated sentences. They are able to communicate and to extract meanings, although their vocabularies will continue to grow and there will be refinements in word meanings. (p. 109)

Some things remain to be learned, of course. Gibson and Levin discuss (119ff.) the ability of children between 4 and 7 years of age to segment phonemes, syllables, and words. This is a good section with a fine selection of studies presented in detail, though with little actual data. The concluding summary is clear-cut and focused on reading instruction:

> What can we say now about children's abilities to segment speech? There is no doubt that in speaking and understanding language, pre-school-aged children can

> automatically discriminate units as small as the distinctive features of the phoneme. They do not confuse pat and bat, for example. In natural language use, however, there is no reason for the child to attend to the details of phonology. He listens for meanings and communicates meanings. These are the first units he abstracts, and . . . meaning units take priority in the child's analysis of speech. Sequences of words composing a meaningful utterance are difficult for the child to analyze into lower-order units.
>
> When the experimental task requires the analysis of phonology, the syllable unit is available to the child, perhaps because the syllable has characteristics like the presence of stressed vowels and intersyllabic pauses which facilitate its abstraction from the speech stream. For children, and to some extent for adults, phonemic analysis is unnatural and difficult. Under natural language conditions, it is hard to conjure up a situation in which the child has to analyze speech at the phonemic level. . . . children can learn to analyze language in phonemic segments, but usually only after training. (p. 125)

The remainder of the chapter is devoted to a rambling discussion of language development in morphology, vocabulary, grammar, and word meaning. Much of the coverage is tangential to reading, and the review is of uneven quality. For instance, Anglin's (1970) rather careful research of the development of general and specific word features is dismissed as "unconvincing." Gibson and Levin believe that development is from the general to the specific, while Anglin's data show that under certain conditions specific distinctions precede general ones. Nelson (1973) has reported findings supporting Anglin, showing how task, materials, and background affect the results of research on this question.

Vocabulary development is of paramount importance in learning to read. The extent of the literature on this topic is shown by the voluminous compendium of Dale, Razik, and Petty (1973). We find particularly interesting the recent research on the subjective lexicon. Gibson and Levin make reference to this latter area, including Miller's (1969) original study, and the monographs by Fillenbaum and Rapaport (1971), and Anglin (1970). There have also been careful studies by Henley (1969) and Kintsch, Miller, and Hogan (1970). The burgeoning research on the subjective lexicon aims to show how words are organized in human memory. The organization is fixed for specific word classes (e.g., verbs of possession) but may vary from one word class to another (e.g., verbs of possession are organized differently than names of animals). The studies show the significant effects of task variation and developmental level. The direct relevance of this work to reading remains to be established. But one cannot gainsay the importance of vocabulary knowledge to reading acquisition, and studies of the subjective lexicon represent a breakthrough in understanding how vocabulary processes operate. More generally, psycholinguistic research on semantics is an active field, with an outpouring of research on semantic-associative theories (e.g., Anderson & Bower, 1973; Smith, Shoben, & Rips, 1974; Anderson & Ortony, 1975).

Gibson and Levin summarize the section:

> The problem of meaning has occupied psycholinguists, linguists, and philosophers at least since the time of Aristotle. Empirical work is in its infancy, however. The approach using semantic features is attractive, but an appraisal of the eventual value of this line of theory and research awaits many years of research. (p. 150)

This is a modest return on such a lengthy discussion.

One further detail in this chapter that we must quarrel with is the treatment of Jakobson's distinctive-feature theory (110ff.). Two criticisms seem warranted: the use of the word hierarchical, and the comparison between data on phoneme production and data on letter confusions. A hierarchy is a system organized in a series

of nested levels, each successive level independent of the next. Gibson and Levin represent Jakobson's description of English phonemes by a hierarchical diagram--incorrectly so, in our opinion. Vowels and consonants comprise a hierarchical split because the features for vowels (e.g., narrow vs. wide) are different from those for consonants (fricative vs. nonfricative). For vowels and for consonants, each organization is better described as a series of orthogonal dimensions: for instance, the typical consonant is represented by a combination of the dimensions labial-dental, palatal-velar, and fricative-nonfricative. The child's ability to represent these dimensions develops over time, the labial-dental dimension coming in first and so on (p. 116). The description of the development of phonology by these dimensions is useful, but it should be stressed that not every structure is a hierarchy.

After discussing Jakobson's work, Gibson and Levin emphasize that they also drew a tree diagram (their Figure 2-3) to represent confusions between the capital letters of the English alphabet. "Though the two domains subjected to a distinctive feature analysis--sounds and letters--are different, it is important to notice that the general model for analysis is the same and the general forms of the outcomes are similar" (p. 115). Actually the letter-confusion data were analyzed by Johnson's hierarchical cluster program, which imposes a hierarchy on a data matrix no matter what the underlying structure is (cf. p. 18). So the similarity between Figures 2-3 and 5-2 represent the authors' choice of analysis. The diagrams could have been drawn differently had one wished.

Word Perception

"Can we learn anything . . . from research on the perception of a word?" (p. 189). Here, the cognitive psychologist finds a practical problem to his liking. After asking the question, Gibson and Levin pose the issue: When can a set of data collected under one condition yield information applicable to a different set of conditions? But they sidestep this vital issue to examine the research literature from another perspective: "[Research on single-word perception] . . . is an interesting body of research in its own right,

and gives us some answers about the formation (or extraction) of higher-order units" (p. 189). That this research interests some investigators cannot be denied; whether it enlightens us as to higher-order units in reading is another matter.

Word-perception studies are fairly basic research, but Gibson and Levin try to stretch them to cover some practical problems.

> Only certain combinations of letters or sounds can be a word. Knowledge of these rules even in the skilled reader is tacit rather than explicit, but it is there and has been shown to be used to great advantage. Children acquire this knowledge slowly, partly because it is implicit, but it is crucial for reading programs to provide the kinds of experience that will provide maximal extraction of the conditional relations in English orthography. (p. 224)

This quotation portrays in miniature some features that leave one dissatisfied with this book. No one would quarrel with the first statement, but it scarcely depends on the research preceding it. The second statement raises a conceptual problem: What shall be meant by a "rule"? What are the rules relating letters and sounds? What does the evidence show about how readers make use of these? The third statement in the quotation makes several assertions without clear justification. Do children actually acquire letter-sound knowledge "slowly," in the sense of gradually, or is the learning of a more insightful character? What is evidence on this issue? Is the knowledge of letter-sound correspondences generally implicit? Many reading programs try to make it explicit. How does conscious knowledge of the rules affect the rate of learning and the application of the correspondence? How is a teacher or researcher to interpret a phrase like "maximal extraction of the conditional relations of English orthography"?

But back to a question closer to the laboratory: What is it that makes some words easier to recognize than others after a brief tachistoscopic flash? Understanding the processing sequence would answer this question and

others of related interest. This understanding would include statements about the perceptual units in word perception (letters? letter fragments? letter combinations? word configurations?) and their relation to each other in pronounceable or otherwise familiar patterns. Psychologists have studied these questions for years (e.g., Neisser, 1967; Calfee, 1975b, chapter 10; Massaro, 1975). "Familiar" words, those that occur frequently in printed text, are easier to recognize; the Thorndike-Lorge count and other such frequency indices are quite accurate predictors of perceptual thresholds, but so are other variables, like pronounceability.

After discussing several studies on the role of pronounceability, Gibson and Levin describe a study by Gibson, Shurcliff, and Yonas (1970) comparing the performance of deaf and hearing students. The interpretation of most studies of pronounceability have been clouded by the fact that "a word's pronounceability and its orthographic legality have been confounded" (p. 205). Since by definition deaf subjects cannot react to pronounceability, one might expect an interaction; hearing subjects should be affected by pronounceability but deaf subjects should not. In fact, the two groups of subjects performed about the same. Gibson et al. concluded from this result that the orthographic properties were more important.

This study illustrates some problems common to this type of research. As Gibson and Levin note, confounding word characteristics is difficult to avoid. In the Gibson et al. study, the correlation between rated pronounceability and orthographic legality ran as high as .63. The hearing subjects may have responded to pronounceability (auditory encoding?), orthographic legality (visual encoding?), or both. That the deaf subjects did not react to pronounceability seems likely, but not certain. Although the subjects were selected to be congenitally deaf, or nearly so, and maximally deaf, they were certainly not typical of deaf subjects, most of whom have severe retardation in all forms of language. That hearing subjects use the same process in reading as deaf subjects is far from certain.

The most potent predictor of word recognition in this study has escaped notice in most reviews. This factor, which accounts for more than two-thirds of the variance in scores of both hearing and deaf subjects, is the length of

the word. The chief finding (not mentioned) is straightforward: The more letters there are in a word, the longer it takes to identify.

What about the role of meaning in word perception? The issue here is extremely clouded, again, because many variables tend to be confounded, and experimental designs have typically been too weak to separate the influence of different factors. Words rated as highly meaningful occur more frequently in print, have more common spelling patterns, are generally shorter, are more pronounceable, and so on. Gibson and Levin cover this ground and conclude that "the real effectiveness of meaning for creating economical units in reading is probably less attributable to the single word than to sentence context where meaning interacts with grammar" (p. 218).

Meaningfulness probably works largely by availability.[12] Meaningful words come more readily to mind, and so with relatively few clues the student generates a correct guess. For example, "The boy hit the _____" is easy to complete because a clear alternative comes immediately to mind. As Garner (1974) has pointed out, accurate and skilled performance depends on the size and similarity of the set of stimulus alternatives confronting the subject. Presenting a meaningful word in a meaningful context allows the reader quicker access to a small set of plausible alternatives.

When first teaching a child decoding skills, however, it is not clear that we should start by pressing for speeded responses. Instead we might encourage him to analyze the elements in the letter string that make up the word and to formulate a pronunciation that uses that information as completely as possible. When the student attacks a word in isolation, where the goal is analytic identification, meaningfulness and familiarity may well be a barrier; familiar words may actually foster guessing strategies counter to the purpose of decoding instruction. The student should be led to concentrate on structural cues when the goal of instruction is success in decoding the word in isolation.

[12] There may also be some effect of familiarity on perception (pp. 209-210; Smith & Haviland, 1972) but it seems to be modest.

Practical Consequences

Gibson and Levin eschew curriculum research, which is certainly their right,[13] but they fail to observe a caution. If one gives advice about curriculum and instruction--and Gibson and Levin do so throughout the book--then one must respect those principles of instruction that aid the teacher and those concepts of program design that lead to effective learning. Their recommendations on reading instruction are spread throughout the book in a scattered and disorganized array, are often presented without rationale and justification, and in many instances are questionable. Sometimes Gibson and Levin speak from research findings; more often they do not. In either case, advice about educational practice must take into account variation in instructional settings. Teachers differ, students differ, and programs differ. In some situations the mandate that "a child must be presented with sentences and discourse at once" (p. 306) may be appropriate. In other situations it flies in the face of the teacher's plan, the students' needs, and the resources of the program. The one solid finding from curriculum research is that many different teaching strategies seem about equally successful. This finding might mean many things--our belief is that it reflects the impoverished state of curriculum research and the insensitivity of existing measurements. The psychologist could make a contribution here by examining more carefully the processes of teaching and learning in applied settings. Let us see what is reported on these activities.

Early Reading

What is new in the area of prereading skills? This is a topic of personal interest and so I (Calfee) looked

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[13] The last section of chapter 9 concludes with a discussion of three reading programs, all developed and evaluated by psychologists. Here it is especially true that Gibson and Levin would have done better to follow their earlier promise to leave curriculum research for another time. They also say nothing about testing, another applied topic of considerable relevance to reading, which they might have tackled even though they decided to forego curriculum and instruction.

forward to the content of chapter 8. Gibson and Levin begin by devoting considerable space to the important topic of phonological awareness (McNinch, 1970). Young children "know" about phonemes; they use phonetic contrasts continually in perceiving and producing speech, and they are more likely than their older peers to give rhyming or "klang" responses as word associations. Yet nothing in their prereading experience requires them to deal with isolated phonemes or phoneme patterns in quite the same manner as reading does. The task is not to improve auditory discrimination, nor is it to become better at distinguishing patterns (training to discriminate between a doorbell and a siren is unlikely to speed up reading acquisition); rather, it is to become more aware, at some level, of phonemes as elements in the stream of speech. The task is more difficult than Gibson and Levin suggest; teaching a child "stinky pinky" is not always easy, and phonological awareness requires more than training in rhyming production.

Gibson and Levin next discuss scribbling and writing, and the perception of visual patterns, including letters and letter strings. Children get better at using pencils and crayons as they grow older, but there is little evidence that the development of this skill bears much relation to reading. Similarly, visual perceptual skills are well developed by age 4, yet children do need guidance about the strange ways that adults use words like "same" and "different." There is little evidence to support the customary practice of having children trace letters and perform other such acts with ditto sheets (e.g., Rand, 1973). The data on visual perceptual training in kindergarten (p. 243) and first grade indicate that it improves visual perception skills but that it has no effect on reading (Rosen, 1966; Smith & Marx, 1972).

Cross-modal matching is discussed for several pages. Surprisingly, the rather complete review by John Paul Jones (1972) is not mentioned. The idea behind this research paradigm is straightforward--reading involves the transmission of information from sight to sound. Therefore, a test requiring comparison of visual and auditory information should tell us something about the adequacy of the channel between modalities. One such test has the student listen to a series of pencil taps and match these to a series of printed dots. It correlates moderately with reading--of course, almost everything

does. Bryden's study (1972, p. 249) is one of the most comprehensive and clear-cut of the many investigations on this topic. He tested students on various combinations--visual-visual, auditory-auditory, auditory-visual, visual-auditory, and so on. The subject's average performance over all the tests was calculated and proved to be significantly related to reading achievement. But none of the test combinations was differentially related to reading achievement. In particular, poor readers were no more likely to do badly on the cross-modal tests than on the other kinds of tests. We know of no evidence to support the hypothesis of specific cross-modal deficit, but we shall undoubtedly continue to see more studies of the problem.[14]

Another old chestnut is the role of letter names in learning to read. With Sesame Street, almost every middle-class child arrives in kindergarten knowing the names of the letters of the English alphabet. Is this knowledge helpful, harmful, or neither? Experts have taken all possible positions on this question (Venezky, 1975). The student who arrives in the first grade knowing the letter names is more likely to succeed in learning to read; but this is correlation, not causality. Several studies have shown that simply teaching the letter names in isolation does not have much effect on later success in reading (Jenkins, Bausel, & Jenkins, 1972; Silberberg, Silberberg, & Iverson, 1972). Knowledge of letter names is one indicator of the student's background. The child who has learned the alphabet before coming to school has likely been exposed to other elements of reading, may even have learned to read already, and hence will do quite well on a reading achievement test at the end of first grade.

This question seems to be one of the tempests-in-a-teapot that plague reading. It probably does not hurt a youngster to learn the letter names. These are relatively easy to acquire, certainly easier than letter-sound associations, and they give him a handle on the graphic symbols. This experience may, through learning-to-learn

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[14] Neither is there any evidence to support the notion that some students are "visual" learners and others are "auditory" learners. To the contrary, research from the laboratory (Jensen, 1971) and the classroom (Robinson, 1972) argues against this idea, but it is another one that dies hard.

or general transfer, make it easier to learn the letter-sound associations subsequently (Hoover, 1976). The student still has much to learn before he becomes a reader.

Chapter 9, "Beginning to Read," is the longest chapter in the book (except for the final part/chapter). The length is surprising, given the introduction:

> Despite all the current emphasis on literacy, the wealth of programs commercially available, the "learning specialists" who have set up in shopping centers, and the arguments over phonics or whole-word methods, it is the beginning phase of learning to read that we seem to know least about. All the talk is of what the teacher does or should do and not of what happens or should happen in the child. This is a very peculiar situation. There is presumably a learning process going on, but it is a rare psychologist who studies it. The approach to beginning reading has most often been how to remedy things when the program hasn't worked and the child didn't learn. (p. 264)

If there isn't that much research (and we agree with this judgment), what is there to say? One could discuss longitudinal and case studies; many are old, but the careful and recent work of Durkin (1966, 1974) fits this category. One might examine the miniature reading-acquisition studies,[15] or patterns of oral-reading errors.

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[15] As a group, these are poorly controlled and of limited generality. The subjects have sometimes been kindergartners, sometimes elementary-school children, sometimes college students. The materials have sometimes used the Roman alphabet, sometimes a different alphabet (e.g., Arabic), and sometimes a synthetic orthography. Sometimes the words have been meaningful, sometimes not. Sometimes the list of letters and words has been reasonably long, most often not (e.g., three or four letters and four to six words). Some studies are mentioned here by Gibson and Levin, others are discussed elsewhere in the book (e.g., Levin's studies on set for

There is some research now on the relation between the instructional program and what the student learns (e.g., Barr, 1974).

Gibson and Levin, however, begin the chapter on a quite different note; they discuss motivation. Their chief proposition is that instrinsic motivation serves best as the driving force for language acquisition--witness Ruth Weir's son delivering soliloquies night after night before sleep with no obvious external motivation. Ashton-Warner's approach to teaching reading is given as an example of the sort of program that fosters intrinsic motivation by fitting it to the child's individual experiences. The approach is appropriate for those occasions when the goal is meaningful reading. On the other hand, we question whether "items like zowie, whee!, bicycle, and birthday cake are just as good vehicles for learning about letter-sound correspondences as see baby" (p. 268). The knowledgeable teacher uses the youngster's natural language to focus attention on decoding principles when that fits and works on word meaning when gynecologist turns out to be the "word for the day."

Behavior modification techniques modeled after operant conditioning are discussed next, with emphasis on the work of the Staats. The limits of these techniques are emphasized--external rewards maintain behavior only so long as they continue in force, and they are not easily used to teach "comprehension and inference." These are pertinent criticisms but hold for many techniques for promoting motivation. What is missing is a balanced discussion of the instructional situations in which external reinforcers help. Behavior modification can help to reduce misbehavior, establish a work "set," and maintain attention on the task. The techniques provide an opportunity for instruction and are not ends in themselves.

How does a student read a word? Some read more rapidly and accurately than others, and some read in a different manner than others. The evidence on this last point is scattered, but the student who sees man and says "main" responds to different aspects of the stimulus than

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diversity are described earlier in the book but not referenced in this section), while others not at all (e.g., Ackerman, 1973; Williams, 1968; Sullivan, Okada, & Niedermeyer, 1971).

the one who says "baby." Gibson and Levin do not say a great deal on this topic ("individual differences" is not indexed), but it seems worth some attention in this review.

Where do these differences come from, and how are they best characterized? The tendency is to ascribe them to the individual--more able students read better than less able students, boys read less well than girls, students from "disadvantaged" backgrounds read more poorly than those from more advantaged backgrounds, and so on. Abundant evidence supports these as correlational propositions, but the evidence reveals little about the underlying causal mechanisms. Correlation is not causality, and it is not proper to say that a student is a poor reader because he is a boy, or dumb, or poor.

A small but growing body of experimental evidence does exist relating differences in reading to variations in teaching practices. For instance, some students react to a novel word as a problem in letter-sound analysis. The word cofe, for instance, is taken apart letter by letter. The letter c has two common pronunciations, as in cat and city, the former being more common and signaled when followed by a consonant or the vowels a, o, or u. The letter o, when it stands as a single vowel, has two common pronunciations, as in cone and cot. The first pronunciation is usually signaled by a single consonant followed by a vowel; the second pronunciation is signaled by a single consonant followed by a blank, or by a double consonant. The letter f is pronounced regularly as in fun. The letter e in final position is regularly unpronounced, and usually serves to mark the so-called long pronunciation of the preceding vowel. Given possible exceptions to each of these regularities, still the most reasonable translation is "koaf", rhyming with loaf. Some students typically handle a novel word in this manner, and the evidence suggests that they tend to be more capable readers (Venezky, 1974); their performance on comprehension tests is better than average, they tend to agree on a single pronunciation of a synthetic word, and they make few "wild" responses when tackling an unknown word.

Most students who use a word-analysis strategy do so because they have been taught to. Barr (1974) reviews the literature supporting this statement, going back to Gates and Boeker (1923). Her own research findings from

controlled classroom instruction provide the best evidence presently available. She shows that the student can be taught to follow another pronunciation strategy, well labeled by Goodman (1967) as a "psycholinguistic guessing game." The student who uses this strategy, when uncertain about a word, gives a response from words in the text, a response that fits the syntactic requirements of the phrase and makes sense. The length, first letter, and possibly the overall configuration of the word influence the guess. This strategy is promoted by training in which (a) the teacher begins the reading lesson by stressing the salient new words in the passage, thus telling the student which words are good guesses for the lesson; (b) the teacher encourages guessing; (c) the words selected for reading include so few common patterns that the student has no basis for inducing regularities; and (d) decoding principles are not emphasized or are obscured altogether. Such training has been called the sight-word or "look-say" method.

The research reviewed by Barr and her own findings show that the teaching method substantially affects the reading strategy employed by the student. In Barr's study, of 16 children taught by a phonics method only one showed clear-cut evidence of using a sight-word strategy after a year's instruction; of 16 children taught by a sight-word method, only one showed clear evidence of using a decoding strategy (this was the ablest student in the group.)

Gibson and Levin (281ff.) do touch on the relation of instruction to reading strategy when they discuss Biemiller's study (1970) of oral reading errors.

> Biemiller's phases undoubtedly are influenced by the type of reading instruction that the children are receiving [meaning as well as decoding was emphasized]. . . . Many children start school with the notion that reading is speaking with books open in front of them. The speech is not nonsensical. Still, the earlier the realization by the child that what he says must be determined by what is printed, the better is the progress for early reading achievement. (p. 282)

They do not mention Biemiller's rather strong statement about what he sees as the implication of his findings.

> The study has two major educational implications. First, it suggests that the encouragement of the early use of contextual and picture cues, as now recommended in most basal reader series (Chall, 1967, p. 215), may well be ill-advised. Data presented in this study indicate that the child's first task in learning to read is mastery of the use of graphic information, and possibly, of the notion that one specific spoken word corresponds to one written word. The child's early use of contextual information does not appear to greatly facilitate progress in acquiring reading skill. The longer he stays in the early, context-emphasizing phase without showing an increase in the use of graphic information the poorer a reader he is at the end of the year. Thus, the teacher should do a considerable proportion of early reading training in situations providing no context at all, in order to compel children to use graphic information as much as possible. As they show evidence of doing so (through accurate reading out of context) they would be given contextual material to read. (Biemiller, 1970, pp. 94-95)

This statement is consistent with Barr's findings as well, but it is inconsistent with Gibson and Levin's insistence that meaning must be stressed from the beginning.

The point is simple. To understand the process of word recognition, the researcher must take into account individual differences in the translation process and, for full understanding, must trace these differences to classroom antecedents. Research on reading that aims for generality must be sensitive to the quality as well as the quantity of individual differences, and it seems certain that the research will have to link up with the practices used in the classroom to train reading skills (Bond and Dykstra, 1967; Chall, 1967). Controlled experiments on these problems are feasible and informative.

Another example suppporting this last proposition is found in selected studies on the relation of a student's sex to reading achievement. It is well documented that girls perform better than boys on standardized reading tests in the primary and intermediate grades. Gibson and Levin discuss sex differences at two points (pp. 270, 492). They note that the teacher's expectations influence the student's success in learning to read, and the sense of their discussion seems to be that sex differences result from cultural influences. Other hypotheses have been put forward to explain the difference: slower language development of boys, hormonal or genetic differences, less adequate socialization of boys for the demands of school.

Researchers have examined the interaction of teachers with boys and girls, have measured the opportunity for learning by boys and girls, and have investigated the reward system employed by teachers for boys and girls. These studies show observable variations in the way boys and girls are handled in the classroom and in opportunities to learn to read (Kolzynski, 1974). When students are trained by computers (Atkinson, 1974; Atkinson, Fletcher, Lindsay, Campbell, & Barr, 1973) or by programmed instruction (McNeil, 1964), boys perform as well as girls. When McNeil's students were moved from programmed instruction to a regular classroom, the sex differences reappeared.

Gibson and Levin cover research on pictures in children's readers. This literature is very straightforward: The presence of pictures is detrimental to acquisition of word-analysis skills. Children rely on the picture to make guesses and hence do not have to work on the more difficult task of deciding how to translate the words. There are probably few topics in the research literature on reading where the evidence is more convincing and solid; hence our surprise at Gibson and Levin's conclusion: "The meagre experimental evidence regarding the relationship between pictures and word learning indicates the superiority of the word alone, but one should not hastily dismiss the aesthetic and semantic contribution of the illustrations to the text" (p. 333). Whether pictures assist in reading acquisition or not depends upon the purpose of a specific instructional activity. If the goal is to teach word-analysis skills, then pictures hinder. If the goal of the instructional

activity is to promote comprehension and vocabulary development, then pictures may help.

There seems little doubt (Walker, 1973) that the literature on curriculum research in reading is weak and not entirely trustworthy. However, for all its weaknesses, curriculum research incorporates the variations in learners and instructional methods that a theory of the reading process must be prepared to handle. Researchers cannot continue to settle for the psychological model that fits the college sophomore or the student taught by the anonymous teacher in an anonymous fashion. We believe that presently existing data provide significant clues about the classes of variables important in fashioning a more adequate model, and we think it is a mistake to ignore curriculum research in designing experiments on the reading process.

Writing Systems, Letter-Sound Correspondence, and Decoding

Discussion of these vital topics begins with chapter 6, which is something of a smorgasbord. There are bits on the history of writing, the effects of typographical variations, cues from print and cues from speech, a discussion of orthographic principles, and a brief account of spelling reform.

A reasonable theme might center on the features in a writing system that link written symbols to spoken language.[16] Written language is a cultural invention and so varies from one society to another in more fundamental ways than does the spoken language. Logographs, syllabaries, and alphabetic writing systems are the three principal varieties of writing. Chinese is the only major modern language that relies on logographs; Japanese and

[16] Gillooly (1972) has recently reviewed the literature on writing systems. His report, an earlier unpublished version of which is referenced by Gibson and Levin, is well organized and suggests clearly how the orthographic system in English, though difficult for the beginning reader, provides advantages to the more accomplished reader. A different approach to the topic has been taken by Olson (1975); his review is most interesting, controversial, and his references superb.

Korean use syllabaries.[17] Most of the rest of the world has adopted an alphabetic writing system, where letters or letter combinations stand in correspondence to phonemes. There is considerable variation in the degree of consistency of spelling-sound correspondences from one culture to another, ranging from those fairly regular like Finnish and Spanish, on the one hand, to "American English" whose inconsistencies reflect its multinational character.

After nine pages of text, mostly about Japanese syllabaries, Gibson and Levin mention what may be the most remarkable generalization that can be made about variation in writing systems.

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[17] In a later section, Gibson and Levin do return to the concept of a syllabary. Gleitman and Rozin (1973) propose an American syllabary as a remedy to reading difficulty. They feel that "awareness of phonological segmentation" is lacking for many school children when they begin reading instruction (there is considerable evidence to support this proposition) and that this lack of awareness is a stumbling block to success in reading. Rather than search for ways of increasing phonological awareness, Gleitman and Rozin propose to circumvent the problem altogether; they replace the alphabetic principle with a syllabary based on the rebus. Gibson and Levin describe this program and its evaluation in some detail, departing from their earlier promise to eschew curriculum research. They report one particular advantage of the method: "The child succeeds early in `reading' something" (p. 289). One of the difficulties with much curriculum research, as Gibson and Levin note, is that it tends to be rather superficial. The criticism bears with force here. What is it that children are learning and what is the transfer of these principles to later reading? One might even suspect negative transfer, given that the final goal of reading is acquisition of the alphabetic principle. Gibson and Levin are not unaware of this problem: "Whether [this method] transfers to phonemic analysis and facilitates learning of it is not known; this experiment provides no evidence" (p. 289). Given the lack of evidence and the rather obvious criticisms of the method, one wonders why they decided to spend almost two pages on the topic.

> In general, though the evidence is meager, there are few aspects of reading which can be attributed to the graphic characteristics of writing systems. This speculation echoes Gray's (1956) conclusions from his cross-national study of reading for UNESCO. He found reading skills to be remarkably similar regardless of the language being read. These findings do not mean that the process of reading is not influenced by the nature of the writing system, but that the outcomes are alike. It seems reasonable that different levels will involve attention to and abstraction of different aspects of the orthographic system. Readers of a syllabary must search for invariances at one level, readers of an alphabetic system at another level. But the skilled readers of one system are able to read as efficiently as skilled readers of another. (p. 165)

In the section of chapter 6 (cf. also pp. 267-305) that is most significant for researcher and teacher, Gibson and Levin describe the work of Venezky (1970) and Noam Chomsky on English spelling-sound correspondences (they do not mention Wijk's [1966] work, an interesting supplement to the other two investigators). Certainly there is no more trampled ground than the debate over "the usefulness of phonics generalizations" in English. On the one side are arrayed those who claim that the many exceptions to any rules for English pronunciation render the rules useless for instruction (e.g., Burmeister, 1968; cf. also Bukovec, 1973). On the other side are those like Venezky and Noam Chomsky who have sought to find the order in English spelling, and those who have put this knowledge to use in the design of instructional systems (e.g., Durkin, 1965; Desberg & Cronnell, 1969). The analytic eye of the psychologist could usefully criticize the methodology and clarify the issues. For instance, one gimmick for inflating the percentage of "irregularities" in English is to count the frequency of occurrence of function words (of, was, and do are good examples) in fairly simple text, where function words predominate. This practice yields a great number of irregularities that are more apparent than real.

English is an alphabetic language, and the correspondences between letters and sounds follow definable patterns. These are not necessarily one-letter-to-one-sound; few languages follow this pattern. Rather, a richer, more complex code exists that signals derivational meaning as well as pronunciation. For instance, we no longer pronounce the final b in bomb, and it serves no obvious function until one considers derivations such as bombardier, bombard, or bombardment. Similar comments hold for patterns such as sign and signal. Taking into account the range of information communicated by spelling patterns in English, Chomsky concludes that English spelling is optimal. In this context, optimal means that the spelling of the key morphemic elements is preserved to the maximum feasible extent, thereby maintaining a consistent spelling-to-meaning correspondence. English spelling provides a wealth of information while maintaining a reasonable relation between letters and sounds. The student who fails to acquire this basic principle and reads English words as Chinese logographs has failed to grasp a principle of remarkable power--and the evidence is that many students do fail to grasp this principle (294ff.).[18] Our suspicion is that this failure can be traced to their instruction.

Other points of view can be found, of course. Some educators feel that English letter-sounds are too inconsistent to be learned, or that the alphabetic principle itself requires understanding at too abstract a level for many students. There is no evidence that a simpler set of letter-sound correspondences would facilitate beginning reading. The great debate over the initial teaching alphabet (ita) may provide the soundest evidence that absolute consistency of letter-sound correspondences is not essential. Developed in England under the auspices of Pitman, ita was designed to reduce

[18] A scholarly evaluation of the alphabetic principle, its history, and its cultural significance can be found in Goody and Watt (1963). In their opinion, "The notion of representing a sound by a graphic symbol is itself so stupefying a leap of the imagination that what is remarkable is not so much that it happened relatively late in human history, but rather that it happened at all" (p. 315).

the demands on the beginning reader. This alphabet has no consistent advantage over traditional orthography, but neither is it any worse (cf. Bond & Dykstra, 1967; Warburton & Southgate, 1969). It does seem to produce poorer spellers and does lose the semantic correspondences in English that Chomsky thinks important.

The serious student of letter-sound correspondences should reflect on the considerable variation in spoken English. Dialect illustrates most obviously the general principle that a spoken word varies with the context, who is speaking, and under what conditions. But the phenomenon is more diverse and pervasive. Consider the statement, "What you just said is crazy!" Said quickly to a friend, it comes out "Whuchujesed is krazy!" How is an orthography to track the wide variation in a word's pronunciation--what, you, just, in this example--without losing the integrity of the written word. Surely no one would propose that a word be spelled differently every time it occurs; yet this is implied by a literal rendering of letter-sound correspondences. The beginning reader seems undisturbed by the natural variations. As Gibson and Levin point out, even the skilled reader is surprised to discover that he pronounces the final s differently in cats and dogs. Preexisting language habits take care of this variation; the speaker understands the plural marker and its variant rendering after voiced and unvoiced consonants. Chomsky's counsel on this matter remains sound, in our opinion.

> Conventional orthography is highly appropriate, with little modification, for a wide range of dialects. To the extent that this point of view can be substantiated, it would follow that the teacher of reading is not introducing the child to some new and obscure system that is only distantly related to the spoken language he has, to a substantial degree, already mastered. Rather the teacher is engaged in bringing to consciousness a system that plays a basic role in the spoken language itself. (p. 4)

It would hardly make sense to introduce the beginning reader to such basic principles of sound-letter correspondence as the vowel-

> shift, the principles of stress assignment, and so on; nor is there any particular reason why the teacher should be aware of these processes or their detailed properties. These rules, it appears, are part of the unconscious linguistic equipment of the nonliterate speaker. He uses them freely in interpreting what is said to him and forming new utterances, though quite without awareness. What the beginning reader must learn (apart from true exceptions) is simply the elementary correspondence between the underlying segments of his internalized lexicon and the orthographic symbols. (pp. 15-16)
>
> For the moment, our understanding of sound structure does not, so far as I can see, lead to any very surprising conclusions regarding the problems of literacy or teaching of reading. It may very well be that one of the best ways to teach reading is to enrich the child's vocabulary, so that he constructs for himself the deeper representations of sound that correspond so closely to the orthographic forms. At the earliest stages, one would obviously make use of materials that do not involve abstract processes and do not depart too far from the surface phonetics. Beyond such relative banalities, I do not see what concrete conclusions can be drawn, for the teaching of reading, from the study of sound structure, although, as noted, this study may have profound implications for human psychology. (Chomsky, 1970, p. 18)

One may argue that Chomsky oversimplifies. Francis (1970) felt that Chomsky had overstated the point in saying that the English orthographic system stood in a "virtual one-to-one correspondence with the segments of the internalized lexical representations" (Francis, 1970, p. 51). But overstatements are an occupational hazard. Gibson and Levin maintain the converse: "There are few one-letter to one-sound correspondences in English"

(p. 291). In fact, several consonants are one-to-one for all practical purposes, and a set of simple vowel correspondences with transfer value to later reading can be used to create an interesting lexicon for beginning reading. The Pittsburgh Reading Program (314ff.) is constructed along just such principles. The student does not have to begin by reading words like pneumatophore. A large number of words suitable to his experience can be formed by a fairly simple set of regular letter-sound correspondences. Once learned, the way is open to the acquisition of more complex correspondences. This was Bloomfield's point almost half a century ago, and it still has merit (Bloomfield & Barnhart, 1961).

Some educators take it for granted that skilled knowledge of letter-sound correspondences is fully acquired by about the third grade. We actually know very little about this matter nationwide. It is difficult to design a multiple-choice, machine-scorable test of decoding ability. Educational test makers have measured what is convenient to measure: vocabulary knowledge and comprehension. Research described by Gibson and Levin (294ff.) suggests that (a) the acquisition of letter-sound principles is difficult for many children; (b) the formation of generalizations does not occur naturally; (c) many reading tasks lead the child to guess on the basis of minimal orthographic cues, pictures, and sentence context; and (d) even as late as college, many students have not acquired certain rudimentary letter-sound principles well enough to transfer them to a new context.[19]

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[19] The several studies on reading acquisition by paired-associate learning make it obvious that if principles are to be learned, instruction must aim toward the development of generalizations. It is true that "the ideal procedure for teaching generalizable knowledge of orthographic rules is still a matter of ignorance to us" (p. 304). Nonetheless, one of the most informative studies on this question (Silberman, 1964, not in the discussion here, about ten pages earlier, p. 292) gives us the key to the learning of transferable skills: "The children in the experiment were in the lowest quartile in reading readiness in the low first grade in a culturally deprived neighborhood. They did not show automatic transfer until they had specific practice in decoding novel words within the training program. Teaching sounds

The reasons behind this state of affairs may have to do with the preparation of teachers and the materials available for teaching reading. Chance determines whether primary and intermediate grade teachers are well trained in the elements of reading; many states require only one course in reading. Teachers who have themselves learned to read without a full understanding of the alphabetic principle (and there are some) will experience difficulty in teaching this principle. In the mélange of materials in a typical reading program, one finds both the sound and the questionable. The publisher's strategy, in the absence of solid evidence on what really works, is to include everything that might help and let the teachers decide what fits their particular needs. Unfortunately, this perpetuates old "saws" like the one quoted by Gibson and Levin: "Should one teach such verbal rules as 'When two vowels go walking, the first one is talking,' or is there a better way?" (p. 299). We hope there is a better way because this "rule" is wrong about as often as it is right. It is a good example of the kind of pseudo-principle that is blindly repeated in the face of contrary evidence.

Meaning and Decoding

Another question of importance in reading instruction: "Can we assume that meaning comes automatically with 'decoding' to sound, since the child has already progressed a long way in developing his semantic system for speech?" (p. 277). Reading builds upon the existing language system, so if the student can manage some sort of translation of print into a reasonable sound approximation, will he not automatically achieve meaning? Gibson and Levin indicate that they do not believe this is so: "It is true that meanings of words have great saliency for children--they attend to them rather than the word's phonetic features, or graphic

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independently, and then 'blending' was not successful. They needed practice in generalizing the decoding skill. This procedure finally proved effective for reading new words. The children did eventually succeed in generalizing the relation to a new word, but practice in the transfer strategy itself was required" (p. 292).

features when they begin to read. But that does not mean that a child has an instant program for extracting meaning from the written word" (p. 277). Of course, the argument is not whether the child has any "instant program," but whether the translation into a spoken representation mediates meaning through the regular channels used in comprehending speech.[20]

Evidence on this point comes from study of error patterns in oral reading. Here the chief interest has been whether errors reflect semantic-syntactic constraints, graphic constraints, or both (277ff.). The findings are inconsistent; at various stages in the development of reading skills, each of these patterns dominate. Gibson and Levin draw the sensible conclusion that "It is difficult to reconcile these [contradictory] findings without knowing the details of reading instruction which the children received" (p. 282). We agree fully. The studies do show clearly that under certain conditions the reader responds to both classes of constraints. So it is startling to read, a few pages later, "the important lesson we have learned from the study of early reading errors is that young children find it difficult to attend to syntactic-semantic and graphic information at the same time" (p. 284). While possibly true, it is not a reasonable inference from the evidence. Under certain conditions, the student is more responsive to the letter patterns; other times, he appears to make a guess, designed to make sense of the text, that is only partly dependent on graphic cues. But quite often the student's response reveals a compromise between the demands of meaning and of print. The program of reading instruction, the character of the task before the reader when tested for oral reading errors, and the nature of the reading materials should all affect this balance.

What are the relations between decoding and reading-for-meaning in early readers? Access to the meaning of a printed word may demand that decoding proceed with ease and quickness, what Laberge and Samuels (1974) call automaticity. It is possible to overload the human information-processing system so that certain tasks

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[20] It is not obvious that for the beginning reader the phonetic and graphic features of a word are overridden by the meaning; this probably depends on the instructional program and the student's state of learning.

ordinarily within the person's capacity cannot be performed. Ask a skilled reader to read mirror-image text (Kolers, 1970), and then ask for comprehension. The reader will call out the words haltingly, one by one. He can, if accuracy is stressed, manage to read every word correctly; decoding is perfect. But his mind is taken up completely with the demands of performing an unnatural task; nothing is left over for the job of understanding what he has read. This is the challenge to the beginning reader, for whom decoding is still an operation that engages him fully. He may be accurate, but he will be slow and his attention will be fully occupied.[21] He cannot be expected to gain "automatic" access to meaning under these conditions. The same phenomenon can be observed in regular spoken discourse, as McNeill (1968) has noted. If a message is delivered at too slow a pace by the speaker, the listener loses the thread and understanding fails. The comprehension of speech has its pace, and, when this is disturbed, the decay of partially processed information begins to take its toll. When the skill of translating from speech to sound begins to move quickly and smoothly, so that relatively little mental effort is expended on the translation, then we can ask whether the student gains automatic access to comprehension. To this extent, we challenge Gibson and Levin's pronouncement that "what the child reads must make sense" (p. 289) that "learning to read at the beginning must involve sentences, even if the child does some guessing" (p. 290). Certainly at times this is sound advice, but it is also possible for a student to spend considerable time reading aloud a Bloomfieldian list (fan, tan, ran, lan, san) with little concern for meaning. He may, in fact, carry out this task with interest and enthusiasm when he sees it as a way to achieve competence. Up to a point the beginning reader decodes slowly, inaccurately, and with considerable effort. Under pressure to read whole sentences, he is likely to drop

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[21] These conditions might produce the phenomenon mentioned in the Cromer paper discussed earlier, in which students decode but do not comprehend. However, decoding would be performed slowly and with effort. This should be a transitory stage in reading acquisition, in any event. As the student acquired speed and accuracy in decoding, he could attend to meaning.

attempts at word analysis, and adopt a guessing strategy. While this strategy meets his immediate needs, it is poorly suited to long-term goals in reading.

Skilled Reading

Chapter 10 is a collection of topics that apparently could not find berth elsewhere. Labeled "The Transition to Skilled Reading," it includes little that bears on that topic. Topics covered are the relations between spelling and reading, subvocalization, eye movements and reading, and grammar and comprehension. Perhaps the chapter heading is poorly chosen. The transition to skilled reading is not a discernible event but a succession of stages that occur over time and in diverse ways.

Some of the material in this chapter would have been better placed elsewhere. For instance, eye movements and eye-voice span would have made more sense in the chapter on learning to read. The literature on eye movements has changed little in the past few decades, although computerized eye-movement systems (Rayner, 1975; Fisher, 1973) may add some new wrinkles. Eye movements in reading reach a stable level by about third or fourth grade. These seem to come as a more or less automatic consequence of acquiring reading skill. Training eye movements has been attempted in the past, to no real avail--the operation goes the other way; improved reading leads to improved eye movements.

The interpretation of the eye-voice span procedure remains a bit of a puzzle to us, as does the cloze procedure. The subject reads a passage aloud while looking into a tachistoscope. When he reaches a particular word, the experimenter turns the lights off in the device, and the subject continues to "read" as much as possible of the text that he has just seen. The voice, typically, is several words behind what the eye has seen, and so the subject does have some information to go on. The findings are fairly straightforward. Older and better readers can produce more of the text after "lights out" than can younger and less competent readers. And virtually everyone stops at a natural syntactic break. People do not use dangling expressions like "It was difficult to hold his attention for"; they either truncate to "It was difficult to hold his attention," or make a

guess about the missing material, "It was difficult to hold his attention for long" (cf. p. 364).

Present and Future States of the Psychology of Reading

Our impression is that other efforts to treat the psychology of reading (e.g., Huey, 1908; Anderson & Dearborn, 1952; Smith, 1971) have more nearly achieved their purposes than have Gibson and Levin. Perhaps Gibson and Levin have aspired to greater purposes. However this may be, their book leaves something to be desired in terms of its theoretical formulations, its critique, its interpretation and integration of the research literature, and its guidelines for future research and practice.[22] Perhaps they have done the best that is possible given present knowledge, but we think there is reason to be more optimistic.

What do we see as the main themes in the psychology of reading at present? A reviewer has the responsibility to summarize and integrate and to propose viable alternatives where appropriate. We shall try to do so now, though the attempt must be brief and almost impressionistic.

What Do We Now Know?

What can be learned from the data base that exists? We have a smattering of research on the acquisition of reading. We have large-scale curriculum studies (e.g., Bond & Dykstra, 1967). The latter show that the name is not the thing; we will have to look more closely at the process of classroom instruction to discover why a program succeeds in some instances and does not in others. Some suggestions appear in reviews by Dunkin and Biddle (1974) and Brophy and Good (1974), but the major conclusion from large curriculum studies is that it does not matter whether a program is called ita,

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[22] The proofreading also left something to be desired; the number of errors and omissions in the printing we received were annoying (e.g., pp. 45, 50-52, 347-348, 416).

phonics, open-classroom, individualized, or what have you. The name over the classroom door, whether placed there by teacher, principal, or experimenter, is not so important as what happens inside that classroom. More analytic investigations will be needed to gain an understanding in this area (Calfee, 1975a).

But back to the question--what else can be learned from present research? There are several things:

> 1. Simple, familiar words are easier to recognize, pronounce, and interpret than those that have more complicated spellings, occur less often in speech and print, and represent concepts that are not part of the student's experience.

We know how to write text that is relatively easy to read, though this knowledge is not always put into practice (e.g., Sticht, Caylor, Kern, & Fox, 1971; Sticht, 1975).

> 2. Some people read more quickly and accurately than others, and by a different set of processes. These differences relate to stable characteristics of the student which predate entrance to school; less is known about causal relations.

We can do a fairly accurate job of predicting which students will benefit from classroom instruction and which ones will not (Calfee, in press). Putting this knowledge to use for improving instruction is another matter.

> 3. A skilled reader can perform remarkably well under a variety of changes in the visual stimulus; his reading skills and concepts transfer readily to other contexts.

He can handle, for instance, a new orthography and a relatively new sound system, as English readers discover when they learn Hebrew or Arabic. The college student "reads" French or Spanish (in the sense of translating from print to sound) long before the result is meaningful.

> 4. Some youngsters (generally from homes with higher incomes and better educated

parents) come to school knowing more about reading and being better equipped to take advantage of the instruction provided by the typical classroom teacher.

Other youngsters are less well suited for schooling, and for them instruction must emphasize the principles that promote transfer in reading and the skills that make reading easier.

5. Most readers seek meaning in what they read and, when uncertain, will respond in a way that makes sense.

6. Methods of teaching and type of curriculum affect what a student learns about reading and how well he learns it.

Few generalizations are possible about factors that mediate these effects, but it is clear that teachers matter (Good, Biddle, & Brophy, 1975; McDonald & Elias, 1975) and likely that programs matter (Chall, 1967; Stallings, 1975).

What Would It Be Nice to Know?

The conclusions above are largely descriptive. They do not tell us much about *how* the mind operates during reading. It is here that the dearth of good theory hurts most. But certain fundamental questions can be raised, where partial answers are available and where future research and theory should focus attention. If we do not have all the answers we would like, we know enough to say that these are the vital questions:

1. What is "the basic perceptual unit" in reading?

The answer is probably that there are several such units, depending on the reader's background and present set, the task, and the materials presented for reading. At times a reader proceeds letter by letter (if he knows how to); at other times, the word is the unit of analysis; under some circumstances the reader may meet his needs by a glance at

a page. We still have much to learn about how the reader chunks the printed information during the few hundred milliseconds that the visual image allows for transmission from eye to brain.

2. As information is processed during reading, how does it change over time?

Gough (1972) provides one sketch of what might happen, based on laboratory studies of skilled readers. The information passes through visual, acoustic-phonetic, lexical, syntactic, and "chunk of meaning" stages. The criticism that reading does not always happen in this fashion is off the mark. Gough has presented a plausible model, which accounts for how some readers operate in some situations. It organizes a fair amount of research. It may have some testable consequences. Let the skeptic propose plausible alternatives, and distinguish them from Gough's proposal.

3. Reading builds upon certain aspects of existing language. But questions remain. Which aspects of existing language are actually critical to the acquisition of reading skills and the development of facility in using those skills?

The evidence suggests that production of "proper" speech is unimportant (this conclusion goes back to Templin, 1957), but that awareness of phonological concepts is important, that syntax takes care of itself, and that the size and availability of the vocabulary is a major consideration. Since Binet's time it has been known that vocabulary knowledge is one of the better predictors of school success, including reading achievement.

4. Reading builds upon thinking skills. Which of these skills are most central to reading, and how can the best use be made of the skills available to a given student?

This problem seems difficult to treat in any general way at present. It may become more amenable to investigation

as our definition and determination of "thinking skills" become more precise. For instance, the ability to generalize or to "use logic" seems complicated, but a fair amount of evidence can be brought to bear on the conditions that promote transfer, and on the intellectual skills that foster the development and use of principles. Some students are more inclined than others to look for generalizations, but most can be taught to think this way in a particular situation.

This list leaves untouched some important areas--motivation, affect, and attitude--that bear on the reading process. We leave them untouched here not because they are unimportant, nor because there is no pertinent research, but because we lack time, space, and background.

The Need for Theory

There is a dearth of trustworthy theoretical models for almost any segment of the reading process. Some formal models have been proposed for a limited class of word-perception tasks. Otherwise, we have a handful of untested (untestable?) models and a few useful heuristic models. Many psychologists seem to take theory development lightly. Estes's (1959) stimulus-sampling theory is now a quarter century old. It provides a rich, flexible, and testable array of models to describe various aspects of the learning process.

A second array of diverse and profitable theoretical models has been created to serve the needs of cognitive psychologists. Reading is a thinking process of a most interesting sort (Calfee, 1975c), and it is refreshing that psychologists have rediscovered the mind after the long period when it was taboo. The methodological sophistication of the new cognitive theoreticians is considerable. Drawing flow charts of "the reading process" has been popular for some years; these can be formulated in ways that are robust and testable (Calfee, 1975d). Computer-simulation models are a mixed blessing--some are as complex as the phenomena they represent--but the development of models for comprehending and answering questions deserves the attention of those interested in reading as comprehension (e.g., Schank, 1972; Winograd, 1972; Norman & Rumelhart, 1975; Norman, 1973). To be sure, a computer is not essential for theoretical work on comprehension (Kintsch, 1974).

Theory is helpful in guiding and organizing the researcher's efforts, but we also agree with the sentiment attributed by Gibson and Levin to "a great educator": "There is nothing so practical as a good theory." There are few illustrations of the adage in the behavioral sciences--Atkinson's (1975) use of learning models to optimize instruction in reading is one of the most promising efforts. It is worth emphasizing that Atkinson bridged the gap between the laboratory and practical application with the help of theory. Learning models that were developed to describe acquisition of nonsense-syllable pairs served to direct a computer-assisted instruction program through a highly efficient path for teaching basic reading skills to primary-school children.

A vital interchange between the laboratory and the classroom seems most desirable at present--a worthwhile point to stress in ending this review. Theoretical models can serve a natural role in mediating this interchange. There needs to be movement in both directions (Chall, 1975). A substantial base of psychological knowledge exists concerning the acquisition and practice of reading in natural contexts. Much of this knowledge is rooted in applied research on reading. Future research on reading will benefit by looking again to the source--the act of reading and learning to read by a normal person under typical conditions.

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